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Exploring Language Learning with Mobile Technology: A Qualitative Content Analysis of Vocabulary Learning Apps for ESL Learners in Canada

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Abstract

Learning apps are becoming ubiquitous in and out of the classroom. While the number of ESL learnings apps has been increasing dramatically, not much information is available for teachers and learners to evaluate the quality of these apps. The purpose of this study was to explore the apps that are most commonly recommended for language learning, investigate features of commonly recommended ESL learning apps, and develop an app evaluation tool that might inform selection of ESL learning apps for use in teaching or recommendations to parents and learners. This study used qualitative content analysis to study three selected vocabulary learning apps—Duolingo, Johnny Grammar Word Challenge, and AnkiApp. Findings show that there is a lack of ESL reading and writing apps, which indicates the reading and writing apps are not emphasized by the researchers or app developers. The findings also show that the quality app features in curriculum include learning objectives, rich and appropriate learning content, accurate content, various learning activities, and various learning topics; productive app features in pedagogy are detailed feedback on learning, clear levels of difficulty, inclusion of collaboration and social contexts, proper use of gamification, and personalized options; well-design app features in design are appropriate multimedia integration, off-line function, app support, and free of technical issues. The selected apps do not have all the exemplar app features in curriculum, pedagogy, and design. The author developed an app evaluation checklist based on the existing literature, Ontario ESL curriculum, and on the emergent app features in the findings. The app evaluation checklist consists of three categories: curriculum, pedagogy, and design. The exemplar app features are developed into criteria in each category. For example, one criteria in pedagogy is "gives detailed feedback to learners". The findings of this study including the app recommendation,

exploration of exemplar app features, and the development of an app evaluation checklist have potential to guide administrators, policy makers, educators, teachers, and individual learners when selecting quality, productive, and well-designed apps.

Key Words: ESL learning apps, MALL, Krashen's Theory, Autonomous Learning, App Evaluation, Qualitative Content Analysis

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Chapter 1

1 Introduction

In this chapter I give an overview of the background of this study. I start with the social context of the ubiquity of learning apps. Then I explain the definition of ESL as well as the importance of ESL teaching and learning in a Canadian context. Next, I introduce Mobile Assisted Language Learning (MALL), which is the approach of using handheld devices in language teaching and learning. I then discuss the rationale of the study, pointing out the urgent need of app evaluation tools and app recommendations. This is followed by the research questions and purposes of the study. Then, I defined the terms in this study. I conclude the chapter with an overview of this thesis.

1.1 Social Context

Learning apps are becoming ubiquitous in and out of the classroom, and they have had exponential growth since their introduction (Mindog, 2016). Over 400,000 apps are available at digital app stores such as iTunes and Google Play (Dickens & Churches, 2012; Bárcena et al., 2015). Bárcena et al. (2015) observed that schools, teachers, and students have an opportunity to apply this newly identified form of Mobile Assisted Language Learning (MALL) in teaching and learning.

An app or application is "a software program, often designed to run on a mobile device, *[sic]* that allows the user to carry out one or more operations" (Gardner & Davis, 2013, p. 6). Gardner and Davis pointed out that some powerful functions of the apps (e.g., easy access to resources, virtual worldwide interaction, etc.) allow users to interact with content, tasks, and games, and to raise and answer questions. For language learning, those functions have the potential to empower learners to develop several English skills—vocabulary, listening, speaking, reading, writing, and grammar (Levy, 2009; Miangah & Nezarat, 2012; Niño, 2015; Steel, 2012).

1.2 ESL in Canadian Context

My main reason for choosing this topic is my experience and personal interest. I have worked closely with ESL learners, especially in the secondary school level in the past few years.

In this study, *English as a Second Language* (ESL) means to study English while in a geographic location (e.g., country, region) where English is the first or dominant language (Al-Hashash, 2007). An *ESL learner* refers to a student who is learning English in an English-speaking country/region and who needs the language for education, employment, and other basic purposes (Saville-Troike, 2006). In the context of Canada, a student from Quebec whose first language is French is considered an ESL learner when studying English. This is because Quebec has a predominantly French-speaking population (Al-Hashash, 2007). Broadly speaking, ESL learners may speak English as their second, third, or even fourth language. To reflect this, some educators replace ESL with the term ESOL (English for Speakers of Other Language).

In Canada, ESL teaching and learning is in great need because Canada is one of the largest destinations for immigrants from non-English speaking countries (Kirk, 2016). A survey from 2011 show that 25% of the population in Canada does not speak English as their first official language (Statistics Canada, 2015). The number of ESL learners in Canada has increased dramatically over the past few years and it is foreseen that there will be continuous growth in the decades to follow (Lovett et al., 2008). The increasing number of international students contributes to the growth of ESL learners in Canada. Secondary schools are home to students speaking more than 100 different languages (Ontario Ministry of Education, 2007). Loriggio (2017) reported that the rise of international population in secondary school level is five to ten percent each year, and even as high as more than 100% in some districts (e.g., Thames Valley District School Board). Due to the essential nature of language proficiency

for social, cultural, and academic purposes, these students are in great need of additional English learning support.

1.3 ESL Curriculum and Pedagogical Approaches

Johnson (1967) stated that the accepted definition of curriculum is "planned learning experiences" (p.129). The most commonly recognized key curriculum components are objectives, content, instructional methods, and assessment (Johnson, 1967; Sand, Davis, Lammel, & Stone, 1960; Su, 2012).

The ESL curriculum in Ontario's secondary schools (Ontario Ministry of Education, 2007) is designed to provide learners with knowledge and skills with the goal to help them become successful in their social and academic lives. One of the expectations in ESL learning is to "use a variety of strategies to build vocabulary" (p. 18). In order to achieve this goal, the ESL curriculum highlights the following key curriculum elements.

a) Learning objectives--the ESL courses should be designed to help students develop skills that they need to develop proficiency in everyday life English and academic English.

b) Learning content—the ESL learning content is organized in four strands and two broad areas: Listening, Speaking, Reading, Writing, Socio-cultural Competence, and Media Literacy. The courses around these strands and areas should provide ESL learners with rich and frequent opportunities to practice different English skills and to interact with other learners in a purposeful way (e.g., collaborative learning in pairs or in small groups).

c) Instructional methods--it is essential for the teacher to offer instructions and feedback in the learning process. Learning also happens outside of the classroom. Therefore, engaging students in real life activities allows them to practice more

than one language skill at the same time and to choose learning materials based on their personal interests.

d) Assessment--as the process of gathering information from a variety of sources, assessment can accurately reflect how well a student is achieving the curriculum expectations in a subject. As part of assessment, students receive feedback that guides their efforts towards improvement. The ESL curriculum also emphasizes the importance of initial assessment because initial assessment helps determine the learner's level of proficiency in English, and academic achievement in the first place, and therefore the learner can be placed at an appropriate learning level.

In this ESL curriculum, students are placed in five different levels based on their English proficiency in initial assessment. Students who have never studied English are in Level One, students who have studied some English may be placed in ESL Level Two or Three, and students who have studied English for several years may be placed in Level Three, Four, or Five.

Curriculum plays some role in guiding instruction (Johnson, 1967). Based on the ESL curriculum, the Ontario Ministry of Education (2007) also outlines the following effective pedagogical approaches that teachers can use:

a) Ensure that the lessons are integrated with social context rather than being taught or practiced in isolation. For example, students may be involved in learning materials or learning activities related to real life.

b) Allow students to make mistakes. Realize that mistakes are a normal and useful part of the language learning process that allows students to apply knowledge and strategies from their first language and prior knowledge.

c) Help learners bridge their prior knowledge in lessons and practices. For example, allow students to create or access bilingual materials using English and their first language.

d) Provide learners collaborative learning opportunities. Collaborative learning activities allows learners to work together to complete learning tasks.

e) Utilize visuals (e.g., chart, diagrams, etc.) as teaching and learning support.

f) Utilize multiple resources to support teaching and learning (e.g., pictures, printed materials, objects, forms, etc.)

g) Place ESL learners in appropriate learning levels through three procedures: initial assessment, placement, and monitoring. Initial assessment determines each student's educational background, level of proficiency in English, and academic achievement. Placement determines the best program and selection of courses for each student. Monitoring keeps track of each student's progress in second-language acquisition.

h) Start teaching and learning with simple words and essential phrases related to everyday life. Help students read English as soon as they can orally recognize and produce the simple words. help students write English (e.g., the learned words). Engage students in English oral practice.

To sum up, the ESL curriculum in the Canadian province of Ontario emphasizes the four curriculum components including learning objectives, earning content, instructional methods, assessment. Accordingly, some pedagogical approaches are to design lessons in social context, allow students to make mistakes and learn from mistakes, bridge learners' prior knowledge, provide cooperative learning opportunities, utilize visuals and multiple resources, and place learners in appropriate learning levels. The Ontario ESL curriculum, designed for teaching and learning in secondary schools in Ontario, contributes an example of

ESL programmatic curriculum to this study. This curriculum may not be identical to the curriculum in ESL learning apps given the nature of mobile apps. However, the curriculum and the instructional approaches of the ESL curriculum in Ontario may be a useful guidance when I study the curriculum in the apps.

1.4 Mobile Assisted Language Learning (MALL)

MALL stands for *Mobile Assisted Language Learning*. Here the word "mobile" refers to mobile devices. MALL is a new learning approach using handheld and portable devices (e.g., smartphones, tablets, MP3/MP4 players, and PDAs) to improve language learning (Kukulska-Hulme & Shield, 2008; Miangah & Nezarat, 2012). MALL has emerged as a combination of Mobile learning (or "M-learning") and Computer Assisted Language Learning (CALL) (Niño, 2015). M-learning is learning mediated via handheld devices and potentially available anytime, anywhere (Kukulska-Hulme & Shield, 2008,), and CALL refers to the search for and study of applications of the computer in language teaching and learning (Levy, 1997,). According to Kukulska-Hulme and Shield (2008), MALL differs from CALL in "its use of personal, portable devices that enable new ways of learning, emphasizing continuity or spontaneity of access and interaction across different contexts of use" (p. 273). These features of MALL increase the flexibility of where and when learning happens, which makes learning more personalized and effective (Hoppe, Joiner, Milrad, & Sharples, 2003; Kim, Rueckert, Kim, & Seo, 2013; Miangah & Nezarat, 2012). Mobile hand-held devices offer students a convenient way to integrate digital technology as part of the language learning process (Bárcena et al., 2015). Miangah and Nezart (2012) explained that the reason for this is that the connectivity function of mobile devices allows learners to use wireless networks to connect and communicate with learning websites to access learning materials via short message service (SMS), mobile email, and learning apps.

Generally speaking, there are two types of studies about MALL: content-related and design-related (Kukulska-Hulme & Shield, 2008). Kukulska-Hulme and Shield (2008) explained that content-related studies emphasize the development of activity types and learning materials; this type of study often uses mobile devices to deliver content to learners. In contrast, design-related studies address design issues that are related to developing learning materials and activities for mobile devices. My research is content-based because I am studying the pre-existing learning content in the apps instead of researching how to develop app materials and activities.

Hoppe et al. (2003) stated that handheld devices are emerging as one of the most promising technologies that support language learning. With the handiness, convenience, and flexibility of mobile devices, MALL allows students to learn a second language without the limit of time and space (Hoppe et al., 2003, Kukulska-Hulme & Shield, 2008; Miangah & Nezarat, 2012; Niño, 2015). These features of MALL open new pedagogical scaffolding (Kim, Rueckert, Kim, & Seo, 2013).

1.5 Rationale of the Study

Despite the pedagogical promise of language learning apps, it is a great challenge to determine the best apps to use within and outside of the classroom (Kim, Rueckert, Kim, & Seo, 2013). This is difficult due to the nature of the app developers, the features of the apps, and the lack of research discourse on using mobile devices to learn language (Gangaiamaran, & Pasupathi, 2017).

Apps are closely controlled by the app designers (Gardner & Davis, 2013), but not all apps are well-designed. Chik (2014) agreed that some apps have poorly-designed features, particularly free apps released by small-scale and amateur developers. Although literature reveals the collaborative potential mobile devices can offer learners (e.g., Hoppe et al., 2003; Wu & Marek, 2016), Berns, Palomo-Duarte, Dodero, Ruiz-Ladrón, and Calderón Márquez

(2015) argued that learning apps in the market mostly support individual learning because these apps mainly deliver content rather than providing learners with the opportunity to interact with each other. Consequently, some students consider language learning apps not to be challenging enough due to the lack of social interaction and context (Bárcena et al., 2015). Moreover, Chik (2014) observed that although some apps emphasize their educational nature, about two-thirds of the apps in her study lacked curriculum content appropriateness and were based on *games* and *reward*. The learning activities were observed to be gamified through time constraints or aesthetics (Heil, Wu, Lee, & Schmidt, 2016). These game features distract the users from focusing on a single activity and position apps as sources of entertainment rather than as learning tools (Bárcena et al., 2015). Sweeny and Moore (2012) noted that some developer usually depend on in-app purchases or ads to cover the costs of app development and marketing expense. Chik (2014) stated that third-party pop-up ads, in-app purchases, and/or limited access to the content are distracting features.

In light of challenges in selecting apps, Traxler and Kukulska- Hulme (2006) pointed out that evaluation and analysis are key to embedding mobile learning and perhaps to all forms of innovation in learning technology. However, there are few studies that have investigated mobile apps for ESL learning. These studies have often focused on learners (e.g., the demography of users, learners' reasons for using apps, and types of apps used) (Mindog, 2016). Only a few studies (e.g., Nisbet & Austin, 2013; Sweeney & Moore, 2012) have provided evaluation instruments or frameworks for teachers to evaluate the quality of ESL learning apps. As mobile apps become more and more popular in the classroom, teachers need such tools not only to inform their own selection and use of ESL apps in teaching, but also to recommend apps to students and their parents. Given that it is difficult to choose a quality, productive, and well-designed ESL learning app from the multitude developed by

both educators and non-educators, there is a need for exemplars and a list of recommended apps.

1.6 Research Questions and Purpose of the Study

The purpose of this study was to explore the apps that are most commonly recommended for language learning, investigate features of exemplar and commonly-recommended ESL learning apps, and develop an app evaluation tool that might inform selection of ESL learning apps for use in teaching or recommendations to parents and learners. In this study I explored the following questions:

1. What are the common ESL learning apps for mobile devices?
2. What are the exemplary features of ESL learning apps in terms of curriculum, pedagogy, and design?
3. What app evaluation tool could be used to assess the quality of ESL learning apps?

1.7 Definition of Terms

Throughout this thesis I use a number of specialized terms related to learning and digital apps. Here is a list of these terms with their definitions.

Autonomous learning refers to self-directed and self-access learning. Learners are motivated to learn by freely accessing learning materials and making their own decisions of what to learn and how to learn (Al-Hashash, 2007; Kim, 2014).

Collaborative learning refers to "techniques [that] allow students to work together as a team to accomplish a common learning goal" (Ontario Ministry of Education, 2007, p. 40).

Freemium apps refer to apps that are free to download but typically include offers to upgrade to the paid version (i.e., in-app purchase) to gain extra features such as freedom from ads and additional learning content or services (Liu, Au, & Choi, 2014).

Gamification is "the use of features and concepts (e.g., points, levels, leaderboards) from games in non-game environment, such as websites and applications, in order to attract

users to engage with the product" (Sweeny & Moore, 2012, p. 8). I also use the term *game-style* to describe the gamification of an app.

Social aspects refer to learners' ability to share information, ideas, personal messages, and other content via electronic means (e.g., sharing scores in a leaderboard in the app or in a social community such as Facebook or Twitter, sharing learning objectives and attempting similar tasks) (Sweeny & Moore, 2012). Social aspect also includes the context (e.g., location, background, environment) in which the app content is situated in (Huang & Sun, 2010; Wang, 2004).

Textual Corrections refers to a correct answer in the form of short text that is provided to learners when an answer is incorrect.

Utility apps refers to apps that enable "users to quickly access a specific types of information or perform a narrowly defined task" (Ginsburg, 2010, p.1). In this study, I categorize *dictionary apps* and *translation apps* as utility apps because of their quick look-up functionality.

1.8 Overview of the Thesis

This thesis contains six chapters, including this introductory chapter. In Chapter 2 I provide an overview of relevant literature on ESL learning apps, including the promising features of mobile apps, limitations of learning apps, previous studies on ESL learning apps, existing language app evaluation criteria and instruments, and a preliminary app evaluation checklist. In Chapter 3 I lay out the theoretical frameworks that guide this study. I introduce Krashen's Theory to discuss the important role of comprehensible input and the influence of learners' affective filter level in learning efficiency in the learning process using a language app. In the fourth chapter covers the research method of this study, which is to use qualitative content analysis to explore in-depth the app features of *Duolingo, Johnny Grammar Word Challenge,* and *AnkiApp*. In Chapter 5 I present the research findings. I answer the three

research questions by providing an app recommendation list and an app evaluation checklist, and by describing the app features of the selected vocabulary apps including *Duolingo, Johnny Grammar Word Challenge,* and *AnkiApp* in detail. In Chapter 6 I draw upon the entire thesis to analyze the research findings, tying up the theoretical and empirical strands as well as previous studies in order to discuss the app features of ESL vocabulary learning apps in this study. In this final chapter I also point out the limitations of this study and discuss the possibilities for future research in this area.

Chapter 2

2 Literature Review

The purpose of this section is to provide an overview of relevant literature on English language learning apps. I begin by exploring the promising dimensions of mobile apps identified in the literature. Next, I examine the literature on the limitations of ESL learning apps. I then look at reviews of ESL learning apps in the literature. Following that, I present the app evaluation criteria and instruments developed by other researchers. Lastly, I offer a preliminary app evaluation checklist.

2.1 Promising Dimensions of Language Learning Apps

The wide range of mobile devices (e.g., smartphones, iPods, iPads, tablets, Chromebooks and other portable internet-connected devices) has provided students access to an array of digital learning materials (Beach & O'Brien, 2015). These learning materials include apps. Most apps are free (e.g., podcasts) or cost little money, usually less than $10 (Rosell-Aguilar, 2007). Some (e.g., Johnny Grammar Word Challenge) are downloadable on the devices themselves (Chik, 2014), whereas others (e.g., Duolingo) have both on-line and off-line functionalities (Miangah & Nezarat, 2012). Sweeny and Moore (2012) observed that language apps are often designed for stand-alone self-study purposes rather than as classroom support resources. To function independently from instruction by a teacher, apps are developed with a range of functions to support self-study such as the ability for a learner to personalize a list of items by choosing which items to practice, adding their own image or translation (Sweeny & Moore, 2012). In addition, apps have the potential to record complex use input in a precise and reliable manner and to personalize the learning experience for individual learners (Heil, Wu, Lee, & Schmidt, 2016). Heil, Wu, Lee, and Schmidt noted that apps may detect the frequency of different types of learner errors. When presented with this

information, learners may detect mistakes that they may otherwise have neglected (Heil, Wu, Lee, & Schmidt, 2016).

Using apps in the learning process reflects Knud Illeris's *Three Dimensions of Learning*, namely the *cognitive dimension*, the *affective dimension*, and the *socio-cultural dimension*. The literature also identifies several other dimensions of learning to which apps may contribute, including *autonomous learning*, *multimedia dimension*, and *inclusive learning*. Here is an outline of these dimensions:

First, language learning apps have a potential influence on the *cognitive dimension* of learning. For example, apps can lessen learners' cognitive load by offering unlimited access to the learning activities. Having this information stored on a device and readily available at any given moment does not require them to commit vast amounts information to memory (Pachler, 2009).

Second, a good learning app motivates learners and allows them to engage in meaningful and rewarding learning, which have a positive effect on the development of learners' *affective* (e.g., emotional, attitudinal, self-efficacy) *dimension* of learning (Hoppe et al., 2003; Niño, 2015).

Third, second language learning often takes place in the context of interactions with others (Chik, 2014). The *socio-cultural* dimension of learning apps makes the learning communication easily accessible (Pachler, 2009). This communicative potential of mobile learning apps provides learners with a chance to actively participate in learning activities with their peers, teachers, parents, and members of their communities and other communities outside the classroom (Pachler, 2009). Context plays an important role in language learning because context provides additional means for learners to enhance their vocabulary (Heil, Wu, Lee, & Schmidt, 2016).

Fourth, mobile apps have the potential to support language learning through the *autonomous learning dimension* (Al-Hashash, 2007; Reinders & White, 2011; Wu & Marek; 2010). The purpose of autonomous learning is to help learners acquire meaningful learning using the motivational advantage of self-study (Al-Hashash, 2007). Wu and Marek (2010) stated that providing learners with a foundation to develop their ability to adapt and continue learning on their own is the ultimate goal of any academic program, including ESL learning. Mobile apps often monitor learners' progress and engagement, which provides users with learning experiences that suit them and encourages them to make decisions about their own progress (Reinders, 2007). Immediate feedback also facilitates autonomous learning opportunities (Forsythe, 2013). However, Reinders and White (2011) suggested that mobile apps may bring constraints to learners' autonomous learning if the app provides inadequate learning materials and improper guidance. This may restrain learners from taking responsibility for learning vocabulary or spelling, for instance (Murray, 1999).

Fifth, *the multimedia dimension* of ESL apps creates a contextual learning environment using graphics, sounds, images, and texts so students can interpret knowledge and study without additional assistance (Wu & Marek, 2010). This multimedia feature of software downloaded on portable digital tools has the potential to motivate students and help them engage in effective English language learning (Beach & O'Brien, 2015; O'Brien & Voss, 2011). This occurs because learners can choose a convenient and preferred method to receive, interact with, and respond to content (O'Brien & Voss, 2011). In order to maximize the potential of the multimedia in ESL learning apps, Mayer (2014) suggested that multimedia elements should be purposefully added to text.

Sixth, learning apps can promote inclusive learning that supports students of diverse backgrounds and learning abilities (Al-Hashash, 2007; Bocci, Guerini, & Marsano, 2017). Briggs (2015) showed the effectiveness of mobile learning apps for special learning in a

study whose results showed that apps helped learners with exceptionalities such as autism learn vocabulary. Likewise, Bouck, Satsangi, and Flanagan (2016) found that disadvantaged learners were more engaged in an "apps-directed condition" (p. 324).

Several researchers reported that students generally had a positive attitude toward learning with mobile apps. Kim, Rueckert, Kim, and Seo (2013) showed that most students considered mobile apps valuable for the majority of subjects in academic study, including learning language. This is because mobile apps created a personalized and meaningful learning experience for the students, which allowed them to expand their learning experience. 80% of participants in Zou and Li's (2015) survey responded that they were satisfied with their language learning experience using mobile apps. The participants claimed that language learning apps were motivational, convenient, and time-saving. These benefits of mobile devices increased students' willingness to incorporate mobile technology, particularly mobile apps, into their lives and language learning (Kim, Rueckert, Kim, & Seo, 2013; Pachler, 2009).

In conclusion, mobile apps have promising features including portability, affordability, connectivity, ability to detect learners' errors, personalization, and the use of multimedia. With all these promising dimensions of English language learning apps, it vital to take into consideration the implications of mobile devices and apps in curriculum and to provide educational practitioners with training and support they might need to adopt this technology (Rosell-Aguilar, 2007). The literature on the promising dimensions of language learning apps illustrates that the most effective use of mobile apps in ESL teaching and learning is to choose apps that harness several of these dimensions. In the next section I present a summary of the limitations of these apps.

2.2 Limitations of Language Learning Apps

Despite the promising features of mobile apps in language learning, several researchers have argued that the limitations of language learning apps should not be neglected.

Design limitations are a first concern. Bárcena et al. (2015) observed that many apps are only designed to operate on one system (e.g., Android, iOS, or Chromebook) and do not have a counterpart for other systems, making it difficult for some students to access the learning resources.

The next concern is that not all apps use sound pedagogical practices. Poor pedagogy occurs when an app fails to provide extensive opportunities to practice language skills, especially speaking and writing (Niño, 2015). Some apps contain grammar mistakes and technical errors and thus cannot be fully trusted (Berns et. al., 2015; Niño, 2015). Kim et al. (2013) noted that the potential knowledge gap between some app developers and educators may result in poor pedagogical usefulness of the app. Niño also raised the common concern that students found it difficult to apply the knowledge learned from apps to real life because some apps are not closely connected to social contexts. From the perspective of using language learning apps as an independent teaching and learning tool as well as in terms of the scope of the curriculum, Bárcena et al. (2015) pointed out that some apps do not improve every language skill equally.

It is important that researchers pay attention to potential problems related to design and pedagogy when they study ESL learning apps and other language learning apps.

2.3 Studies of ESL Learning apps in Existing Literature

Mobile apps are great tools for language learning because they allow learners to improve their language competency by accessing different aspects in ESL learning (Levy, 2009; Miangah & Nezarat, 2012; Niño, 2015; Steel, 2012). ESL learners often use mobile

apps to learn language skills such as listening, reading, speaking, writing, vocabulary, and grammar. In this section I focus on language skills as I present studies of ESL learning apps.

2.3.1 Listening.

Listening plays an essential role in language learning because it is the first step when learning a new language (Read & Barcena, 2016). Without listening, it would be difficult to practice speaking (Huang & Sun, 2010). In Hoven and Palalas's (2011) research, participants expressed that mobile learning enhanced their listening skills.

Some apps have been specially developed to improve students' listening skills. Huang and Sun (2010) developed a mobile multimedia English practice system to help users improve their listening abilities. This app contains a *multimedia materials* website and an English listening practice system to provide users with extensive listening resources in the forms of video, mp3 materials, texts, and online interactions. From this app, students can access both *on-line and off-line resources* with five *levels of difficulty*, and choose leaning content according to their individual needs and interests. However, this app exists only on a website and is not downloadable. I explain in Chapter 4 that I have excluded apps like this in the app selection for this study. Another app that uses multimedia resources to assist learners' listening skills is *Listening Drill*. This app covers hundreds of learning topics related to everyday life contexts through downloadable visual and audio materials such as TED talks and audio books (Cowan, 2015).

Cowan observed another highly rated English learning app called *Lingo Arcade* (96% positive comments from 25 customer reviews in the iTunes app store). This user-friendly app can assist students with low English proficiency to improve their listening and to learn some simple everyday words like "man" and "woman" through learning activities that include matching an image with a sound/word and rearranging letters into words. Nisbet & Austin (2013) reported that *Clear Speech* has some similar functions to *Lingo Arcade.* In addition,

Clear Speech uses gamification to provide students with interactive listening experiences. With 10 stages of challenge, students practice their listening skills to reach their goals and progress through the game.

2.3.2 Vocabulary.

Steel (2012) stated that mobile apps have remarkable benefits for learning English vocabulary (e.g., for understanding meanings and contexts and memorizing words). English vocabulary apps such as vocabulary games and flashcards are among the most common apps that learners use (Mindog, 2016). Niño (2015) conducted a survey in which 73% of the students responded that mobile language learning apps helped to increase their vocabulary.

The literature on language learning apps notes some mobile apps of high utility for vocabulary teaching and learning, which include: (a) *English LaunchPad*, which contains everyday topics facilitated by many activities such as flashcards and quizzes; (b) *Idioms*, which covers the most common conversational idioms in daily life to engage students in vocabulary building through fun activities and quizzes (Nisbet & Austin, 2013); (c) *Guess it! Language Trainer,* which teaches vocabulary through practice (e.g., guessing word meanings, rating word meanings, uploading word definitions) (Berns et al., 2015). (d) *Busuu*, which helps students with vocabulary acquisition and other language skills (Bárcena, et al., 2015); (e) *MindSnacks*, which provides vocabulary activities in a game style; (f) vocabulary flashcards apps such as *Memrise, Quizlet, Brainscape*, and *Anki*, with which learners can download or design their own English vocabulary flashcards (Niño, 2015); (g) translation apps such as *Google Translate* and *iTranslate,* which help English learners to learn vocabulary and to communicate with others more effectively (Niño, 2015; Nisbet & Austin, 2013); (h) dictionary apps such as *Dictionary.com, TheFreeDictionary* (Chik, 2014), *Wordreference, Dict CC, LEO, Pons*, and *Linguee* (Niño, 2015), which provide word definitions, sample sentences, audio pronunciations, synonyms, and antonyms.

Although previous research has included dictionary apps and translation apps in the category of vocabulary learning, in this study I have separated these two types of apps into a different category: *utility apps.* In this study, I define a learning app as an app that learners can use for independent learning; the app provides opportunities to practice language skills and receive feedback. Due to the lack of teaching elements (e.g., lessons, quizzes), dictionary apps and translation apps do not fit into the vocabulary learning apps category.

2.3.3 Speaking, Pronunciation, Reading, Writing, and Grammar.

Compared with research about apps that are designed to support listening and vocabulary, there is sparse research literature on ESL learning apps specifically developed for speaking, reading, grammar, or writing.

Only two apps in the existing literature were identified as speaking learning apps. *Hello Talk* provides a language and culture exchange community with the purpose of connecting language learners with native speakers to practice speaking (Mindog, 2016). *VISP (Videos for Speaking)* is a speaking app in which learners orally describe what appears on-screen in a limited amount of time (Bárcena, et al., 2015). Some apps that have not been not designed particularly for the purpose of practicing speaking also have the potential to improve learners' speaking skills. For example, English newspaper apps such as *National Post* and *The Globe and Mail* have been noted to be helpful to students in terms of enhancing their speaking and comprehension skills while readers try to understand the news and culture (Niño, 2015). The audio and video materials in *Listening Drill* can enhance learners' speaking skills Cowan (2015).

English Pronunciation, recommended by Cowan (2015), is the only learning app in the literature designed specifically for practicing pronunciation. This app allows users to listen to sentence pronunciation and then record their own pronunciation. The app then scores users' pronunciation accuracy. Niño (2015) stated that the embedded speech-to-text and text-

to-speech functions in *Duolingo*, *Busuu*, and *Babble* contribute to developing accurate pronunciation. Dictionary apps such as *Dictionary.com*, *Google Translat*e, and *TheFreeDictionary* often provide pronunciations.

Several researchers (e.g., Levy, 2009; Miangah & Nezarat, 2012; Steel 2012) pointed out that mobiles apps can help students learn grammar. In Niño's (2015) survey, 32% of the participants responded that mobile apps improved their grammatical accuracy. Nevertheless, few studies recommended grammar apps. One recommended app is *Duolingo*, which features grammar lessons (Munday, 2016), and the other is *English LaunchPad* (Nisbet & Austin (2013).

No previous studies highlighted reading and writing learning apps. However, some apps designed for learning other language skills may benefit learners in ESL reading and writing. For instance, learners can read sentences and learn how to write sentences in *Lingo Arcade* (Cowan, 2015). In the same way, learners can improve their writing skills when creating their own word definition in *Guess it! Language Trainer* (Berns et. al., 2015). Niño (2015) stated that social network apps such as *WhatsApp* and *Facebook Messenger* also offer learners opportunities to practice writing skills. However, these social network apps have been noted to provide some improper grammar and spelling in cases where learners use abbreviations and short forms of words. I will discuss the limitations of some ESL learning apps in Chapter 6.

Overall, these studies show that there is a need to develop better criteria for recommending ESL learning apps, especially those that focus on speaking, pronunciation, reading, writing, and grammar.

2.4 Existing Evaluation Criteria of Language Learning Apps

Teachers face a daunting challenge in selecting suitable digital materials to meet their teaching goals. This challenge is multiplied when teachers have access to digital tools like

mobile apps (Namukasa, Gadanidis, Sarina, Scucuglia & Aryee, 2016). Just as teachers struggle to choose suitable ESL learning apps, learners and their parents are often overwhelmed with the extensive number of apps in the market. As a result, they usually consult family members, friends, or the media for advice. Sometimes they depended on the app descriptions provided by the app developers (Chik, 2014). It is clearly the case that app description from the app store is not sufficient for teachers, parents, and students to make a valid judgement because the description provided by the app store does not always match users' experience with the app (Larkin, 2013). While many teachers and students already know how to access and use apps, they urgently need guidance on how to effectively and strategically search for, select, and use language learning apps that meet their teaching and learning goals (Nisbet & Austin, 2013). In this section I review literature on existing evaluation criteria and instruments for language learning apps.

Several researchers emphasized the importance of evaluation criteria for mobile learning apps (Caffarella, 1993; Hoppe et al., 2003; Kukulska-Hulme & Traxler, 2007; Niño, 2015). Mobile apps with good qualities for language learning should involve social interaction and have *pedagogical potential* to inspire self-directed learning (Caffarella, 1993), engagement, motivation, and social communication (Niño, 2015). A quality app is situated in the learner's *everyday life context* and shows *context-awareness* in the learning activities (Kukulska-Hulme & Traxler, 2007; Wang, 2004). These apps usually have the function to sense users' location, language level, learning environment, and personal interests, thereby creating a dynamic and personalized learning environment (Huang & Sun, 2010; Wang, 2004). Kukulska-Hulme and Traxler (2007) emphasized that personalized app features satisfy users' individual needs. A well-designed learning app integrates multimedia elements purposefully in the learning activities (Mayer, 2004; Schwebs, 2014). Giving feedback to learners is an essential part of teaching and learning because it maximizes learners' potential

at different stages of learning, raises their awareness of their strengths and areas for improvement, and identifies actions they can take to improve performance (Lally, 2013). Without effective feedback, the quality of learning cannot be guaranteed (Smith & Higgins, 2006).

Nisbet and Austin (2013) adapted an instructional sequence from Chamot and O'Malle. This instructional sequence has a *curriculum focus* and *pedagogical focus* on connecting students' experience with the apps. Nisbet and Austin concluded that a useful learning app should have the following features:

a) elicit and draw on students' background knowledge;

b) show (rather than just tell) students how to use the app;

c) point out multiple benefits, features, and uses;

d) engage students in meaningful practice using the app;

e) have students complete an independent task using the app; and

f) provide an opportunity for students to report on the experience afterwards (p. 6).

On the other hand, Sweeney and Moore (2012) recommended a framework with four major technical and pedagogical criteria to evaluate mobile language learning apps. These criteria are:

a) the mobile app contains the right sorts of interactivity;

b) the learning resources include appropriate multimedia contents;

c) the app is designed with high contextual relevance with a suitable level of utility and functionality;

d) the app supports autonomous and personalized learning (p. 14).

Overall, these studies highlighted three aspects of app evaluation criteria and instruments: curriculum, pedagogy, and design. I used these three aspects as the categories in the preliminary app evaluation checklist I present below in Table 1. Previous research,

however, has focused only on one or two of these three aspects, and none of the sets of criteria or instruments is comprehensive. Whilst Nisbet and Austin focused on curriculum and pedagogical practice, the purpose of the instructional sequence is to guide teachers to introduce ESL learning apps to their students rather than being used as an independent app evaluation tool for app users. Sweeney and Moore's framework highlighted criteria from the developer's perspective and for the purpose of app design as opposed to app selection. On the other hand, Namukasa et al. (2016) focused on the curriculum, technical, cognitive, interaction, and interactivity aspects of mathematics apps.

2.5 Preliminary App Evaluation Checklist

In the section near the beginning of this chapter on the limitations of learning apps, I indicated the need for further research to develop a comprehensive app evaluation tool. My research explores an app evaluation tool in response to this need.

Based on my review of the literature, I developed a *Preliminary App Evaluation Checklist.* Not only did I adopt evaluation criteria as demonstrated above, but I also developed new criteria by drawing on Ontario ESL curriculum and research that mentioned promising app features and limitations of apps.

Table 1 shows the preliminary app evaluation checklist. Specifically, I matched each of criterion with a category (i.e., curriculum, pedagogy, and design) in which the criterion fits best. I expected that categories and criteria would emerge once I analyzed the data. This preliminary app evaluation checklist guided me, as I elaborate in Chapter 4, to use a data analysis matrix to explore features of the selected vocabulary learning apps.

Table 1

Preliminary App Evaluation Checklist

Categories	Criteria	Scores[1]
Curriculum	1. Articulates learning objectives that are achievable through the app's content.	
	2. Provides rich, appropriate[2] learning content through different learning activities (e.g., level challenges, and games, etc.).	
	3. Has accurate learning content.	
	4. Provides content activities.	
Pedagogy	1. Gives feedback to learners.	
	2. Articulates the levels of difficulty of the learning content.	
	3. Allows social interaction among learners.	
	4. Integrates social contexts.	
	5. Provides personalized options that can satisfy users' individual needs.	
	6. Facilitates autonomous learning.	
App Design	1. Contains different forms of multimedia (e.g., video, audio, and image, etc.) that are purposefully incorporated in the learning content and activities.	
	2. Has off-line functions.	
	3.No pop-up elements during the use of the app.	
	4. No technical elements that influence learner's overall learning experience.	

[1] A score (1-5) will be given to each criterion according to the researchers' app using experience. According to Vagias' (2006) Likert Scale (http://www.marquette.edu/dsa/assessment/documents/Sample-Likert-Scales.pdf), the score is given based on the following standard: 1 – Strongly disagree, 2 – Disagree, 3 – Neither agree nor disagree, 4 – Agree, 5 – Strongly agree.

[2] In this study, inappropriate content means any sexual or violent text, images or sound that is unsuitable for the app users in secondary school level.

2.6 Summary

In this chapter I provided an overview of the relevant literature on English learning apps. In the first section I explored the promise of mobile apps in different dimensions of learning— cognitive, affective, and socio-cultural—as well as in autonomous learning, multimedia integration, and inclusive learning. In the second section I discussed some limitations of language learning apps. In the third section I reviewed ESL learning apps studied and recommended in the literature. I found that there was a lack of research on language learning apps that focus on grammar, reading, writing, and pronunciation. Next, I presented app evaluation criteria and instruments developed by other researchers in previous studies. Since these criteria and tools are not comprehensive enough, I developed my own preliminary app evaluation checklist, which is an urgent necessity. This checklist, as we shall see in Chapter 5, will be further developed based on the research findings.

Chapter 3

3 Theoretical Framework

In this chapter I discuss the theoretical framework of this study. When researching ESL learning apps, it is important to understand how learners acquire comprehensive input and what effects learners' motivation and confidence. I therefore chose to draw upon Krashen's Theory to guide this study.

3.1 Krashen's Theory

Krashen's Theory has become a predominant influence on Second Language Acquisition (SLA) theories, including ESL teaching and learning. SLA refers to the study of: a) learners who learn a language subsequent to learning their first language; and b) the process of learning that language. The additional language is referred to as a second language (L2), or target language (TL). Despite its name, the additional language could be a third, fourth, or even tenth language (Saville-Troike, 2006). Researchers draw upon a variety of theoretical frameworks, analytical frames, and methodologies to study SLA (Myles, 2013; Saville-Troike, 2006). From Norm Chomsky's Universal Grammar (UG), Krashen's Theory adopted the notion that all learners have innate ability to acquire their native language despite its complexity and abstractness (Myles, 2013). The UG principles have little variation and apply to all human natural languages (Lardiere, 2012).

3.1.1 Comprehensible Input.

Krashen (1989) emphasized the importance of *comprehensible input* (also called *i+1*) in his theory. The letter *i* symbolizes the learner's current English level and the number *1* represents the next level that is just beyond the learner's current language level. In other words, *comprehensible input* refers to the knowledge learners acquire that is just beyond their current knowledge level. Learning does not happen alone. With comprehensible input learner situate language in context. They naturally access and use the information they need,

so acquisition takes place spontaneously (Saville-Troike, 2006).

Some researchers (e.g., Guerra, 1996; Johnson, 1995) were inclined to associate Vygotsky's zone of proximal development (ZPD) with Krashen's comprehensible input (i + 1) (Dunn & Lantolf, 1998). Vygotsky (1978) defined ZPD as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance, or in collaboration with more capable peers" (p. 86). Guerra (1996) believed that comprehensible input is equivalent to ZPD as both theories point out that learners can progress to the next level that immediately follows their actual learning development. However, Dunn and Lantolf (1998) argued that these two theories are not commensurable, claiming that "giving the sharp differences between Vygotsky and Krashen on the interface between learning and development, any attempt to integrate the ZPD and the input hypothesis is misguided and ultimately unproductive" (p.422). Krashen's input theory indicates that an individual's language development is certain, whereas a ZPD perspective holds that the language development is open, uncertain and depends on the interactional contexts to which the learner is exposed (Dunn & Lantolf, 1998). Dunn and Lantolf explained that this is because i+1 emphasizes that the learner acquires knowledge as a loner, whereas ZPD highlights the assistance of other individuals.

Input theory lacks social interaction. Long (1996) found that it is insufficient to improve English proficiency by comprehensible input alone; interaction is required. The main reason is that learners do not have a guarantee for their accurate use of language even when they have strong language skills (Long, 1996). Long further noted that even when errors are not involved, many advanced ESL learners fail to use knowledge that they learned. Furthermore, some of these advanced ESL learners may lack basic vocabulary, are unable to use complicated sentences, or have less sophisticated relativization abilities (Long, 1996).

Long suggested an interaction theory to address the issues of input theory. Long claimed that interaction theory can connect input, internal learner capacities, particularly selective attention, and output in productive ways. Interaction theory highlights that the effectiveness of comprehensible input may be significantly improved if the learner negotiates for meaning (Long, 1996). Long believed that interaction among learners (e.g., role-playing) helps second language learners increase the language input and improves their language proficiency. Through interaction, a learner may learn from a learning partner who may be more competent in the language during frequent communication, repetition, and extensions. The semantically-related interaction is important for language acquisition because the frequencies of the target forms in the reformulations tend to be higher, which increases the saliency of the learning content. This interaction also increases the likelihood of this content being noticed by the learners (Long, 1996). Long pointed out that another way to increase the possibility of the content being noticed is through input modifications (e.g., key words, partial repetition, etc.). Hence, the increased comprehensibility through interaction makes the language components acquirable.

3.1.2 Affective Filter.

On the other hand, Krashen (1989) argued that comprehensible input alone is not enough for acquisition because the learners' *affective filter* affects the amount of comprehensible input they receive. Krashen described affective filter as a "mental block" that may slow down learners' comprehensible input process. This mental block can consist of learners' motivation, self-confidence, and learning interest. A positive attitude and a comfortable learning environment where the learner does not worry about failure can lower the filter and allow unconstrained access to comprehensible input. Alternatively, forced learning (e.g., if learners fear that their weakness will be revealed) creates a high filter, blocking learners' processing of input (Krashen, 1989; VanPatten & Williams, 2015; Saville-

Troike, 2006). Krashen (1989) claimed that learners' filter is the lowest when they are so engaged with the learning material that they temporarily forget that they are learning English.

Krashen's theory is particularly important in exploring ESL learning activities on mobile apps, including vocabulary. Repeated exposure to English (e.g., having unlimited access to practice the same lesson in an app) gives learners a better opportunity to pick out comprehensible knowledge, especially in an English context (Krashen, 1989). Mobile apps have the potential to provide learners with an ESL learning environment where they gain language input and comprehension through app features such as multimedia (e.g., graphics, sounds, animations) and social contexts (e.g., everyday life conversation) (Al-Hashash, 2007). It appears that when a mobile app provides learners with comprehensible input in terms of learning content and activities that allow them to recall their real-life experience, they are more likely to acquire a higher level of skills in vocabulary, grammar, reading, writing, and speaking. Krashen (1989) also believed comprehensible input to be associated with better vocabulary development. The learning process will be more effective if learners see words and sentences in context as they read the words, use them in writing, hear them in listening, and practice speaking them (Beach & O'Brien, 2015; Nelson, 2006; Yi, 2014). Learners acquire vocabulary unconsciously in this way as it lowers their affective filter and makes their learning efficient. Various app features can affect learners' affective filter. The factors for a low filter may include well-designed multimedia integration and personalized options. As I mention later in the discussion chapter, distracting ads and technical errors may create a high affective filter.

3.2 Summary

In this chapter I presented Krashen's theory as the theoretical framework that guides this study to explore the app features of the ESL leaning apps. Krashen's theory guides my study as I investigate whether ESL learning apps provide learners with interactive learning

environments with appropriate levels of knowledge and explore how each the apps affect the learners' affective filter.

Chapter 4

4 Research Method

The research method in this study is a qualitative content analysis. Creswell (2007) noted that in qualitative research the researcher analyzes words or pictures to describe the central phenomenon rather than using statistics. The findings are usually presented through themes or broad categories. In my study I used qualitative analysis to gain insights into the app features of ESL learning apps. I used content analysis as both the research method and the data analysis method.

4.1 What is Content Analysis?

Krippendorff (2004) defined content analysis as "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use" (p. 18). The "texts" in the definition do not only mean written text, but also include images, sounds, art works, magazines, social media, signs, and numerical records (Flick, 2009; Krippendorff, 2004). Elo, Kääriäinen, Kanste, Pölkki, Utriainen, and Kyngäs (2014) noted that content analysis can be used in both qualitative and quantitative research in an inductive or deductive way. They explained that in an inductive content analysis, categories are created from the raw data without a theory-based categorization environment, whereas a deductive content analysis is based on a pre-existing categorization matrix or coding scheme. The content analysis I used in this study was both inductive and deductive. It was deductive because I adopted the preliminary app evaluation checklist I developed in Chapter 2 as the data analysis matrix. It was inductive as I further developed the matrix with the categories and themes that emerged from the analysis of the data using the preliminary checklist.

In recent years there has been an increasing amount of literature that explores mobile apps through qualitative content analysis. Yamanaka (2015), for example, used content analysis to explore the culture of learning with educational iPad apps. Likewise, Cowan et al.

(2013) used content analysis to study the effectiveness of health fitness exercising apps. Content analysis has increasingly been used in research areas including nursing (e.g., Elo & Kyngas, 2008), library and information science (e.g., Marsh & White, 2006), political science (e.g., Grimmer & Stewart, 2013; Marsh & White, 2006), business (e.g., Cleave, Arku & Chatwin, 2017), psychology (e.g., Leech & Onwuegbuzie, 2008), and journalism (e.g., Mellado, & Van Dalen, 2017). Content analysis has also been used in education, specifically in curriculum research (e.g., Al-Jaro, Asmawi & Hasim, 2017), health education (e.g., Cowan et al., 2013), language learning (e.g., Lin & Lan, 2015), and digital materials in learning (e.g., Cowan et al., 2013).

I used content analysis to understand the features of the selected vocabulary apps. The "texts" included all textual and non-textual representations such as video, images, sounds, symbols, activities, and art work in a language learning app. I wanted to understand what these "texts" meant for learning language. Rather than analyzing signs in print, in this study I analyzed signs on screen.

4.1.1 Context of content analysis in this study.

It is of vital importance to make clear the context in content analysis because it explains how the researcher understands the text (Krippendorff, 2004). Without knowing the context, readers might misinterpret the results. The context in this study was that numerous apps were available for learning language, some of which were used by ESL learners. Although a large percentage of learners and teachers used language apps, others did not. Some users used apps recommended by educators, teachers, peers, or other third parties such as forums or magazines. As already noted in Chapter 2 (e.g., Chik, 2014; Nisbet & Austin, 2013), even those who used the apps had little professional and no research-based guidance on how a quality, productive, and well-designed language learning app might read, look, or sound. I analyzed the data using available literature on language learning apps and the

theoretical framework of Krashen's Theory. Using qualitative content analysis, I explored these research questions:

1. What are the common ESL learning apps for mobile devices?
2. What are the exemplary features of ESL learning apps in terms of curriculum, pedagogy, and design?
3. What app evaluation tool could be used to assess the quality of ESL learning apps?

4.2 Sampling Units: Selecting the Apps

As one important step of data collection, sampling is the process of selecting a subset of cases for study from the larger population (Neuendorf, 2017). The purpose of sampling is to select representative data to limit the research effort. In this study, the sampling step in the data collection process involved selecting apps for in-depth exploration. The texts—the apps—were purposefully sampled (Krippendorff, 2004) from apps available in both the iTunes and Google Play stores. I chose to include an app if it:

a) was downloadable to mobile devices including iPad, iPhone, and smartphones as well as tablets with an Android operating system
b) had off-line functionality
c) was accessible in both Google Play and iTunes
d) contained features of a language learning app designed for different language speakers including but not limited to French, Spanish, Chinese, Arabic, Hindi, Portuguese, Russian, Japanese (e.g., various interface languages, language learning activities)
e) was designed for English/ESL/ language (English included) learning
f) was either free, or freemium

This last criterion bears more explanation. I included freemium apps in this study if their overall in-app purchases were under $10 Canadian dollars (CAD). If the freemium app

exceeded $10 CAD overall, I included it only if at least 60% of its content was free. I chose to study apps that were under $10 CAD because I knew from my previous experience as a teacher that most learners would not invest much money to purchase apps. They considered apps that were less than $10 CAD to be affordable. Further, learners appear to be able to learn a substantial amount of English language through the free functionality of the app, so these freemium apps with at least 60% free content were worth choosing. *LingQ* did not meet this criterion because the in-app purchase is $12.49 CAD per month after a one-week free trial. Nevertheless, due to a lack of reading learning apps in the literature and in the app recommendation list in this study, I decided to include *LingQ* in the reading learning apps category in Table 2.

I chose to exclude from this study utility apps (e.g., translation apps, dictionary apps) and social media apps (e.g., WhatsApp, Facebook Messenger) because, although they support language learning, they are not solely designed for the purpose of language learning. Mobile apps operating on iOS and Android systems are dominating the app market for education (Khaddage & Latteman, 2013). iPad has been the leading tablet computer device in the market since its introduction, and it has been marketed as a learning device (Chik, 2014). A high number of students own their personal smartphones, and the majority of them own iPhones (Selwood, 2015). Therefore, I chose to study apps that were available on iOS (including both iPhone and iPad) and Android systems. The selected apps can be downloaded on iTunes app store and Google Play app store. My research excluded Chrome store apps and Windows apps.

In the app selection process, I searched ESL learning apps with key words: ESL (learning) app(s), language (learning) app(s), and English learning app(s). From 20 resources that recommended ESL apps, a total of 144 apps were included in the preliminary list for data analysis (See Appendix A). The resources that recommended the apps appeared reliable as

they were also cited in research (e.g., Namukasa, 2016; Chik, 2014; Niño, 2015), in professional resources and journals (e.g., at the *Center on Innovations in Learning*[3] website, in the *Professionally Speaking* Journal), by third party app analysts (e.g., App Annie), as well as in blogs and websites (e.g., Edutopia). These resources were accessible through Western University libraries and through an online search. Some apps (e.g., Duolingo, Memrise, and Rosetta Stone) were recommended by multiple resources. I counted each app only once, whether I found it at one source or in multiple lists of recommended apps.

4.2.1 Affordable ESL apps.

In order to verify the accuracy of the app information for each of the most recommended affordable apps from the resources, I explored every app on both the Google Play (https://play.google.com/store/apps?hl=en) and iTunes app stores (https://itunes.apple.com/us/app/). From the list of 144 apps, I chose 20 learning apps and 10 utility apps that met all app inclusion and exclusion criteria. I categorized these apps into the *App Recommendation List* by the focuses of the language skills (see Table 2). It is worth noting that these apps were not the most commonly recommended apps in the list of the 144 apps. See Appendix B for the most commonly recommended apps. I only included apps that were recommended at least twice in this list. Most of apps in Appendix B, however, were excluded from the app recommendation list because the cost was more than $10 CAD. Further, just because I grouped an app in a particular category does not mean the app does not promote other language skills. Based on my experience exploring these apps, I decided to group the apps into categories based on the *main* language skill (or skills) the app enhances.

[3] *Center on Innovation in Learning* is "one of 7 National Content Centers funded by the United States Department of Education supporting the 15 Regional Comprehensive Centers (RCCs) and the states they serve." See website http://www.centeril.org/

4.2.2 Early Childhood Education ESL apps.

ESL learning apps for Early Childhood Education (ECE) learners (age 0-8) are designed differently from the apps in this study in terms of user interface and content focus. Only two apps among the most recommended affordable apps in Table 2 are for ECE learners. Using the same app selection criteria I have described in this chapter, I repeated the app search process focusing on ESL apps for ECE learners. Only a few recommended apps for ECE learners were found in both iTunes and Google Play app stores, as most apps were only available in iTunes app store. As a result, I included apps that were available in only one of these app stores. Appendix C contains the list of apps that resulted from this additional search.

Table 2

App Recommendation List (sorted by the focuses of the language skills)[4]

Focus	Apps
Vocabulary (4)	Duolingo
	Johnny Grammar Word Challenge
	Phrasalstein [5]
	AnkiApp
Grammar (4)	Duolingo
	Learn English Grammar
	Grammar Up
	Johnny Grammar's Word Challenge
Reading (2)	Conversation English
	LingQ[6]
for ECE learners (2)	Intro to letters (letters)
	The Cat in The Hat - Dr. Seuss (reading)

Focus	Apps
Listening (4)	EnglishCentral
	Learn English Elementary (Podcast)
	LearnEnglish GREAT Videos
	Listening Drill
Pronunciation (4)	Forvo
	Learn English Words & Phrases
	Souds Right
	Sounds: The Pronunciation App
Speaking (3)	Hello Talk
	Tandem
	Conversation English
Spelling (1)	Johnny Grammar's Word Challenge

Reference Tools	Dictionary (8)	TheFreeDictionary.com-Farlex
		Dictionary.com
		American Wordspeller ESL
		Wordreference
		Dict CC
		LEO
		Pons
		Linguee
	Translation (2)	Google Translate
		iTranslate

[4] There are 20 non-repeated learning apps and 10 reference apps in the app recommendation list. Three apps—*Duolingo*, *Johnny Grammar Word Challenge*, and *Conversation English*—are grouped in several categories.
[5] *Phrasalstein* is a vocabulary app that met all the app selection criteria during data collection, but it was no longer accessible in iTunes app store during data analysis. Because it no longer met the inclusion criterion that the app should be accessible in both iTunes and Google Play app stores, I excluded it from the data analysis.
[6] *LingQ* did not meet the app selection criterion that the app should be less than $10 CA, but due to a lack of reading apps in the literature and in the app recommendation list in this study, I included it here to show users the reading features in the app.

Miangah and Nezarat (2012) observed that adult ESL learners also used mobile apps to learn English because many of them experienced a lack of free time due to their work commitments. The portability of mobile devices has provided adult ESL learners with a new way to learn English at their convenience. I chose not to provide an additional app recommendation list for adult learners because previous research (e.g., Niño, 2015) has shown that adults also use apps recommended in Table 2 to learn English.

4.2.3 Further selection of apps for in-depth study.

In order to explore the quality, productive, and well-designed [7]app features, I chose to do in-depth analysis of the vocabulary learning apps from the list of the most commonly recommended affordable apps (see Table 2). Several reasons explain this choice. To begin with, the literature summarized in Chapter 2 shows that it has been commonplace to use mobile devices to learn vocabulary (Kukulska-Hulme & Shield, 2008). More importantly, Krashen (1989) emphasized that a large vocabulary is essential for mastery of a language. Likewise, Cameron (2001) and Alexander (n.d.) claimed that vocabulary is the building block to learners' English language ability that helps improve all language skills such as listening, speaking, reading, and writing.

Among all the vocabulary apps, several researchers (e.g., Mindog, 2016; Niño, 2015; Steel, 2012) have observed that the apps designed with vocabulary games and flashcards are among the most common apps that learners use. For these reasons I selected the vocabulary apps from Table 2—*Duolingo*, *Johnny Grammar Word Challenge*, and *AnkiApp*—for in-depth study. I did not include *Phrasalstein* in the data analysis because at the time of selecting apps for the in-depth study it was no longer available in iTunes app store.

[7] *Quality* is used to describe app features in curriculum, *productive* for features in pedagogy, and *well-designed* for features in app design.

4.3 Study Materials

In this section I present the study materials I used to access, explore, and preserve the data in this study. I used an iPhone 6 and the iTunes app store to access the data. When I carried out the in-depth study of apps, I recorded the data I collected for the three chosen vocabulary apps through screenshots and documents. Krippendorff (2004) pointed out that recording is an important analytical component for two main reasons. One reason is that it allows the analysts to create durable records of impermanent phenomena such as app history versions and the learning activities in an app. The other reason is that the researcher is able to transform raw data (e.g., unedited texts, original images) into analyzable representations. There are several benefits to recording data: (a) it "bridges the gap between unitized texts and someone's reading of them, between distinct images and what people see in them, or between separate observations and their situational interpretations" (Krippendoff, 2004, p. 84), (b) it allows the researcher to compare the data across time, (c) it allows the researcher to replicate the analysis of the other researchers (Krippendoff, 2004). Like other online sources, ESL apps are often updated quickly. It is necessary to record the data such as the app description, the app content, and user reviews. For example, content in the app description and the app content are updated regularly in certain apps.

I compared *Duolingo*, *Johnny Grammar Word Challenge*, and *AnkiApp* by exploring them on both smartphones and tablet devices for iOS and Android. I found that only a few insignificant differences in the same app existed in the different platforms. One example of the differences was that there were no ads for *Johnny Grammar Word Challenge*, and no Duolingo plus (freemium) option for *Duolingo* on the Android operating system. Other differences, as shown in Figure 1, were screen colors, image orientations, and game rewards. I considered these differences insignificant for the objectives of this study because these app features did not appear to centrally influence users' overall learning experiences. Given that

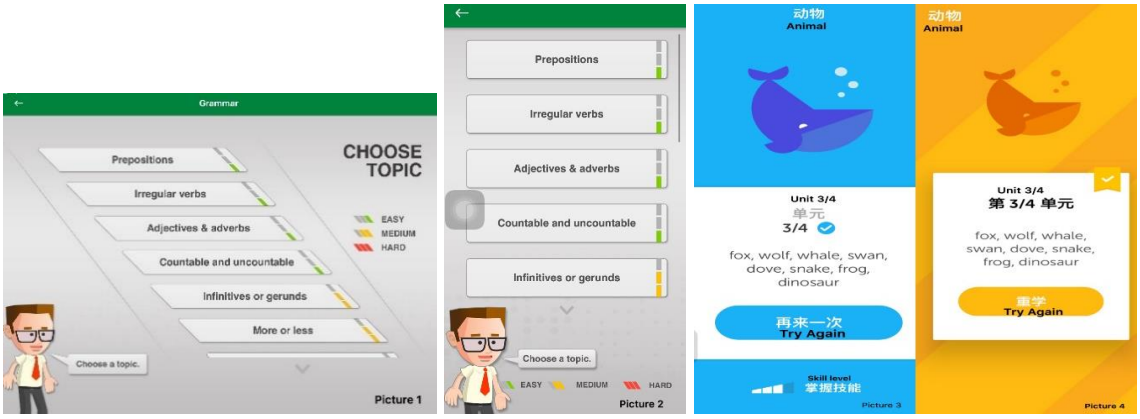

Figure 1. Comparison of the selected apps on different devices. The difference between Pictures 1 and 2 is the orientation. Picture 1 shows the topic page on *Johnny Grammar Word Challenge* on iPad, whereas Picture 2 shows the topic page on *Johnny Grammar Word Challenge* on iPhone and Android phone. The difference between Pictures 3 and 4 is color. Picture 3 shows the "animal" lesson in *Duolingo* on iPhone, whereas Picture 4 shows the "animal" lesson in *Duolingo* on Android phone.

smartphones were the most popular mobile devices among students in many countries (e.g., Australia, U.S., Japan, etc.), most of which use the iOS operating system (Khaddage & Latteman, 2013; Sweeny and Moore, 2008; Selwood, 2015), I chose an iPhone to explore, experience, and study the apps. I used an iPhone 6 in this study because it was the device to which I had access.

The iPhone 6 I used in this study was purchased in February 2015. The size of the device is 5.44 inches (height) × 2.64 inches (width) (or 13.82 cm × 6.71 cm), and the screen size is 4.7 inches (or 11.94 cm). The device has a storage capacity of 16GB and the device's operating system version is iOS 9.3.4. Although this was not the most updated version, all three chosen apps—*Duolingo*, *Johnny Grammar Word Challenge*, and *AnkiApp*—functioned normally on the device. The screen size, storage capacity, and the operating system version of the selected iPhone 6 did not appear to affect the data collection and data analysis processes.

4.3.1 Downloading the apps.

I downloaded the selected apps from the iTunes app store on the iPhone 6. I accessed the app store and searched the name of the selected apps to download directly. Sometimes I needed to sign into the Apple ID before downloading an app. For a paid app, I was required to fill in my Credit/Debit Card information to purchase the app before downloading.

4.3.2 App content transcripts.

I explored each app to become completely familiar with the app content; I accessed each app more than 80 times. I then recorded my experience exploring the app content for each all in details in three documents—one each for *Duolingo*, *Johnny Grammar Word Challenge*, and *AnkiApp*. I stored the Word documents in a local file folder on my computer.

4.3.3 App screenshots.

The screenshots of the app-related activities include the user reviews, all the content in the app description (i.e., editor's words and version history), and the app content.

4.3.3.1 App content.

App content is an important source of data, and it is often regularly updated. Although I recorded my experience of exploring the app in text documents, I also took and saved screenshots as I explored the app content.

4.3.3.2 App description.

The app description of every app in the app store is written by the app developers with the following purposes:

a) to present the intended goals and motives of the app,

b) to introduce the app features from the developer's perspective,

c) to provide some app development information, and

d) to promote the app by listing obtained awards or positive comments for the app from the third parties (see Figure 2 for a sample app description).

Reading the app description allowed me to obtain a more comprehensive understanding of the app quality, based on how accurately the description reflects the actual content presented by the app. I took screenshots of the app description to keep a record of the data.

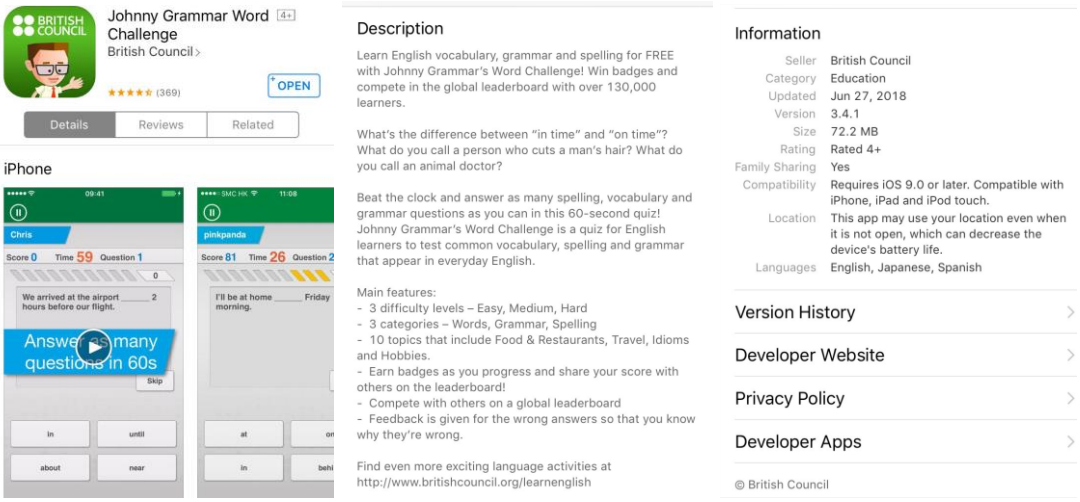

Figure 2. A sample app description.

4.3.3.3 User reviews and version history.

In this study, users are those who use an app for an ESL learning purpose. User reviews are evaluations, comments, and feedback of the app that the users record in the "Reviews" section in the app store. The selected user reviews were important because this study did not involve participants. The user reviews were the only data that disclosed the app features and app quality from a learner's perspective. These reviews also revealed the factors that may influence the learners' affective filter level, and how the app may affect the learners' comprehensible input (Krashen, 1989).

The user reviews in the app store cannot be downloaded or copied to a document. I therefore took screenshots of the selected user reviews to keep a record of the data and then saved the screenshots to a local file folder. I also took screenshots of the relevant app version history (see Figure 3 for a sample). The rationale behind this choice was that it was valuable

for me to see the app version history to understand whether the updates supported users' requests in the user reviews. For this reason, I matched the app version history with user reviews dated from the same time period. *Duolingo* was updated on weekly basis, but there were only twenty-five of the most updated history versions available in the app store. On the other hand, *Johnny Grammar Word Challenge* and *AnkiApp* were updated less frequently, usually less than seven times annually, and their entire app version history was available in the app store. During my data collection, the most updated version of Duolingo was 5.2.7, updated on February 25, 2018, and the oldest version was 5.1.9, released on August 25, 2017. I found 631 user reviews from this time period.

As I did not identify any particular reason to decide the sample size of user reviews in *Johnny Grammar Word Challenge*, I chose the same number of user reviews as for *Duolingo* so as to keep the number consistent. The total number for *Johnny Grammar Word Challenge* in iTunes app store was fifteen, which is significantly insufficient. I therefore supplemented these with 616 reviews from the Google Play app store to make the number equivalent to the number of reviews of *Duolingo*. Because *AnkiApp* only had 71 reviews in total in both iTunes and Google App stores, I included all the reviews.

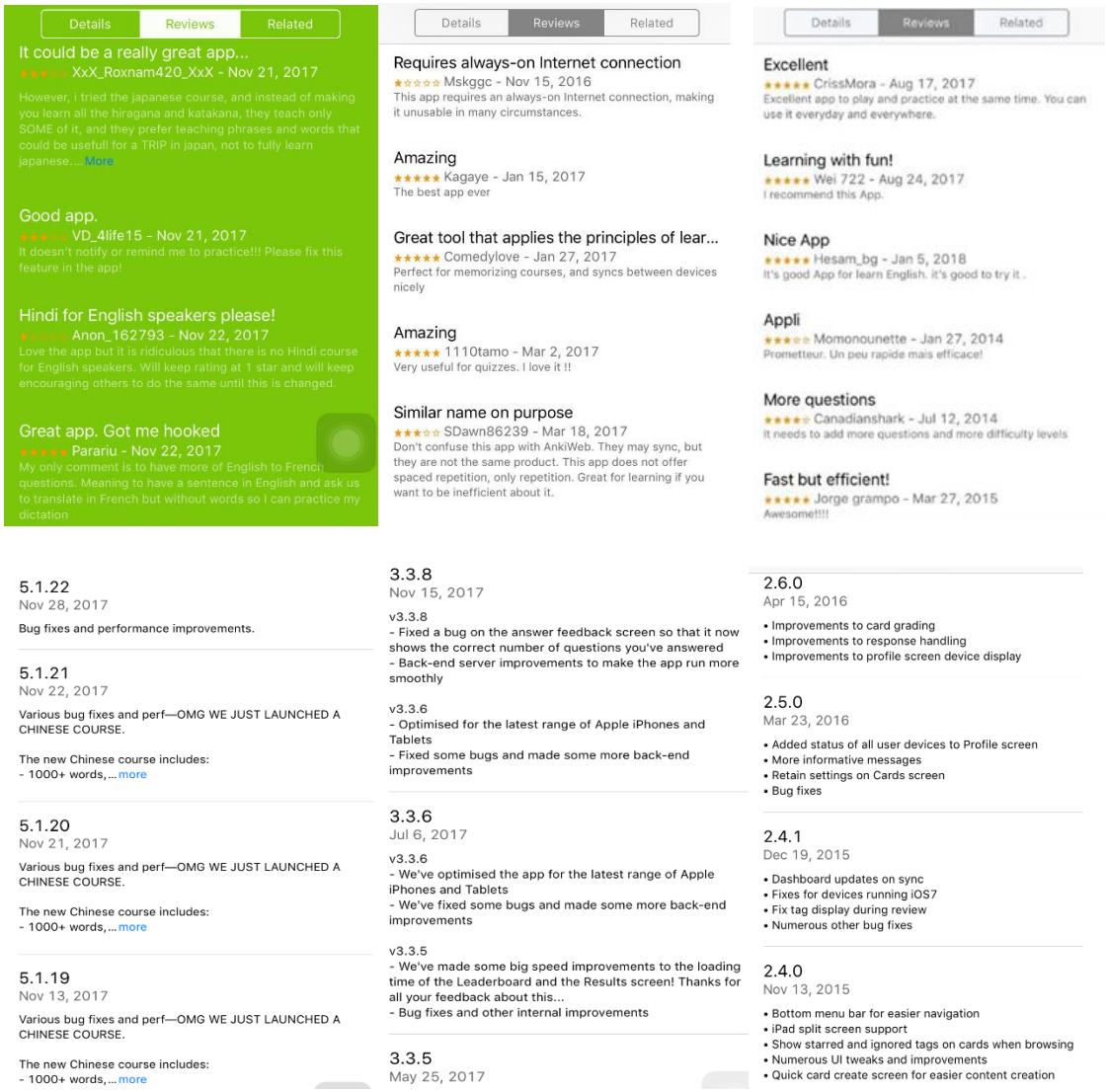

Figure 3. A sample user reviews and history version in the app store. From left to right on the first line are user reviews from *Duolingo*, *Johnny Grammar Word Challenge*, and *AnkiApp*. From left to right on the second row are app version history from *Duolingo*, *Johnny Grammar Word Challenge*, and *AnkiApp*.

4.4 Procedures

Elo and Kyngas (2008) developed a *Data Analysis Conceptual Map* (see Appendix D) that summarizes three main phases in qualitative content analysis: preparation, organizing, and reporting. The conceptual map shows that inductive content analysis and deductive content analysis follow different analytical steps. As I used both inductive and deductive

analysis, I adopted Elo and Kyngas's conceptual map and developed the following data analysis diagram for this study (see Figure 4).

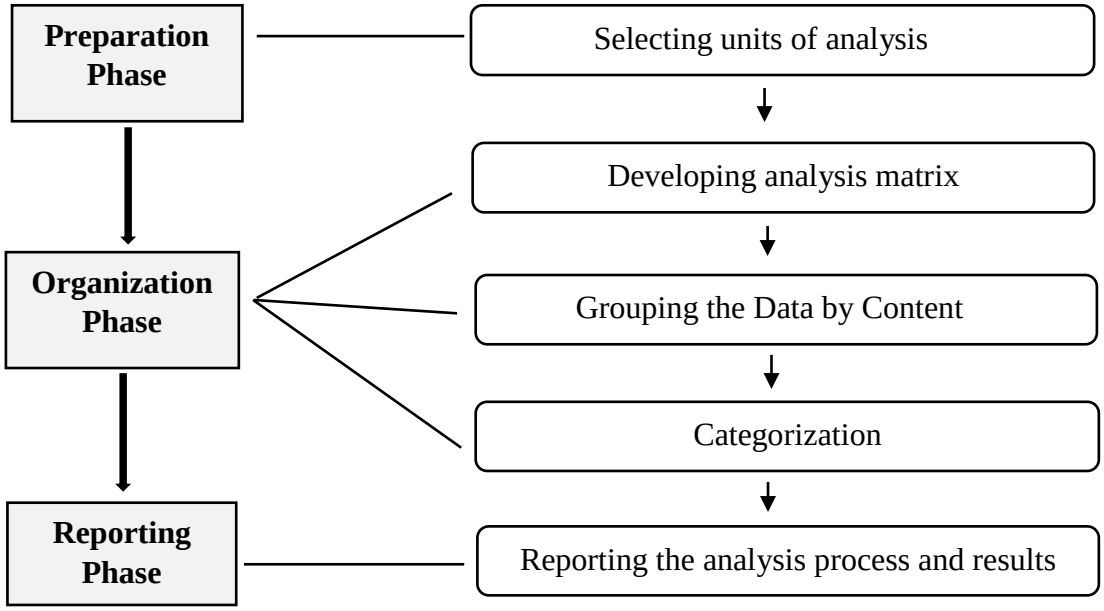

Figure 4. Data Analysis Diagram

4.4.1 Preparation phase--Selecting the unit of analysis.

The unit of analysis is the element on which data are analyzed and for which findings are reported (Neuendorf, 2017, p. 20). *Units*, according to Krippendorff (2004), are wholes that analysts distinguish and treat as independent elements. Polit and Beck (2004) explained the wholeness of a unit of analysis means a particular unit such as a word, a paragraph, or a theme. The unit is the smallest element that cannot be divided again (Krippendorff, 2004). As there are many forms of *text*, the units of analysis may be at different levels, such as a word, a phrase, sentence, paragraph, themes, or the entire text (Cohen, Manion, & Morrison, 2011). Distinguished by functions in the content analysis process, there are three types of units of analysis: context units, sampling units, and recording units. *Context units* are units of textual matter that set limits on the amount of text to be consulted in the description of recording units. *Sampling units* are distinguished for selective inclusion in an analysis. *Recording units*

are distinguished for separate description, transcription, recording, or coding (Krippendorff, 2004). Authors in the U.S. General Accounting Office (G.A.O.,1996) noted that a recording unit is the portion of text to which evaluators apply a category label. When compared with sampling units, recording units are significantly smaller because they are either equal to or contained in sampling units (Krippendorff, 2004).

Cavanagh (1997) claimed that before selecting the unit of analysis, the researcher needs to decide some important factors, including what to analyze, how much detail to include, and how to sample. According to the inclusion and exclusion criteria I mentioned previously, I selected 20 learning apps and 10 utility apps for this study. I chose three vocabulary apps—*Duolingo, Johnny Grammar Word Challenge,* and *AnkiApp*—as the sampling units for an in-depth study. I examined three recording units: app description, app content, and user reviews. I selected these three recording units because these data could triangulate the quality of app features in three different perspectives: the app developers, the users, and the app itself. The context units in this study limited the number of user reviews. For each app reviewed, I explored all the app content and activities using an iPhone. I looked at the app description in the iTunes app store where the app developer talked about the app and I also performed an online search. The number of user reviews was limited to 631 reviews, and app version history to 25 versions.

4.4.2 Organization phase.

After preparation of the data comes the organization of data. I organized and coded the data manually using Microsoft Word and Excel. I stored the data on a laptop in a folder named "data collection and coding."

4.4.2.1 The analysis matrix.

This study was deductive at the beginning because when I first studied the apps, I used the preliminary app evaluation checklist shown in Table 1 as a guide. The checklist

includes criteria such as “articulates learning objectives that are achievable using the app’s content”, descriptors such as “appropriate,” and key words such as “learning objectives.” I took the key words that described an app feature in each criterion as themes (or “sub-categories”) and I considered this checklist as a *Data Analysis Matrix* that is unconstrained and can be modified during the data analysis (see Table 3).

This resulted in the development of a data analysis matrix shown in Table 3. After I developed the data analysis matrix, I reviewed and coded the data correspondingly into the identified themes such as learning objectives, learning content, and content accuracy.

Table 3

Data Analysis Matrix

Category	**Themes**[8]	**Duolingo**	**Johnny Grammar Word Challenge**	**AnkiApp**
Curriculum	Learning objectives			
	Learning content			
	Content accuracy			
	Learning assessment			
	Learning topics			
Pedagogy	Feedback on learning			
	Levels of difficulty			
	Social interaction			
	Social context			
	Personalized options			
	Autonomous learning			
	Learning pace			
	Gamification			
Design	Multimedia integration			
	Off-line function			
	Pop-up elements			
	Technical elements			
	App support			
	In-app purchase			
	Interface languages			
	In-device and online support			

[8] Italicized themes are emergent themes.

4.4.2.2 Data coding.

I used an inductive approach to analyze data including the app description, user reviews, and app content that did not directly fit in the categorization frame of the data analysis matrix. First, I reviewed the data of the app description, app content, and user review of each app in detail. When I was familiar with the data, I divided the app description into several new paragraphs according the central meaning of each paragraph. Similarly, I divided the app content into different paragraphs based on the topic of each paragraph. I assigned a word or phrase to be a heading for each paragraph in this process. I also read all user reviews and labelled each review with a heading that described the main idea of each review.

Second, I read and re-read the paragraphs and reviews as well as each matching heading to make sure they were consistent. Then I combined paragraphs and reviews that had similar topics. I assigned new headings to the new paragraphs and grouped reviews. When the groups formed did not change even when I re-read the paragraphs, these new headings became emergent themes. During the data analysis I added emergent themes such as gamification, and app support.

4.4.2.3 Categorization.

I checked the emergent themes to make sure all the texts were covered (i.e., the themes were exhaustive). Through contrasting and comparing these themes I assigned them to the existing categories. No new categories emerged in the process. The themes represented the app features of the selected apps. I developed the major key features (e.g., learning topics, app support) into criteria for the revised *App Evaluation Checklist* shown in Table 8 in Chapter 5. This modified app evaluation checklist has the potential to help users evaluate the quality of ESL learning apps.

4.4.3 Reporting phase--Reporting the analysis process and results.

Reporting is the last phase in data analysis. In this challenging phase researchers should consider factors such as dependability and detailed description of the analysis process (Elo & Kyngas, 2008). On the qualitative analysis of the apps most recommended by third parties, I reported the results in a tabular format followed by brief descriptions of the apps in each category of language learning. On the in-depth content analysis, as we shall see in Chapter 5, I reported my findings by each individual app and its features. I followed the number of user ratings on the iTunes app store to assign order to the apps when presenting the findings. The higher the user ratings, the more prominently the app appears in the findings. I did this because, from my experience, user ratings are from learners who actually used this app, and their opinions are less likely to be influenced by app developers or by a third party. As a result, I presented in the order of *Duolingo* (17775 ratings), then *Johnny Grammar Word Challenge* (176 ratings), and finally *AnkiApp* (29 ratings). As we shall see later, Tables 4, 5, 6 present a summary of the findings for each app, and in Chapter 5 I provide a detailed report for the findings.

4.4.4 Research procedure summary.

In this section I presented the research procedures of this study. The sample units were *Duolingo, Johnny Grammar Word Challenge*, and *AnkiApp*, and the recording units were app description, app content, and user reviews. I used both deductive and inductive content analytical approaches. Based on the data analysis conceptual map (Elo & Kyngas, 2008), I developed a data analysis diagram (see Figure 4) to guide the data analysis. I categorized some data into pre-existing themes in the data analysis matrix, and the data that did not fit in the categorization frame I coded in an inductive way, which generated new themes and categories. I reported the findings in a tabular format followed by brief descriptions of the apps in each category of language learning by individual apps.

4.5 Credibility and Dependability

Neuendorf (2017) observed that content analysis measures would be meaningless without a satisfactory degree of credibility. A reliable research process should have the same response to a particular phenomenon regardless of how it is implemented (Krippendorff, 2004; Neuendorf, 2017).

Credibility and dependability are two main principles that determine the quality of a research study. Credibility ensures the data is generated with no distortions or biases. I should maintain a similar meaning to everyone so the research results will be transferable. To ensure the credibility of the study, I used triangulation and inter-rater credibility (e.g., supervisory committee and peer coding of the data).

Dependability looks at how accurately the study answers the research question(s) and how it convinces readers of the research descriptions and findings about the people, the phenomenon, events, experiences, and actions involved (Krippendorff, 2004). Neuendorf (2017) pointed out that dependability is a standard of a "good" measurement, and it may be considered as encompassing the criteria of credibility, accuracy, and precision. Therefore, the researcher should present detailed descriptions of the research process, the findings, and the strength and limitations of the study to ensure readers have a clear understanding of how the work was carried out (Elo & Kyngas, 2008; G.A.O, 1996). In qualitative content analysis, elements of dependability are not universal (Elo & Kyngas, 2008) and there is no standard measuring tool to evaluate the effectiveness of the analysis. Any measurement is dependable measurement as long as the user has justified it (Krippendorff, 2004). Hence, to claim a category is dependable indicates the subject under investigation is related to the category (Cavanagh 1997).

I used three types of dependability in this study: face dependability, internal dependability, and external dependability. First, face dependability means the research

findings are obviously true and plausible "on their face" (Krippendorff, 2004). Face dependability is the gatekeeper for all other kinds of dependability (Neuendorf, 2017). According to Neuendorf (2017), the significance of face dependability is for the researcher to look back and examine the measures as freshly and objectively as possible. To check the face dependability, I read other studies with similar topics to this study to compare the research method. I also invited colleagues in other domains (e.g., music, medicine) to read the data analysis process for feedback.

Second, internal dependability is used to see if the researcher has explored that which was proposed to explore (Neuendorf, 2017). I accessed and explored each app more than 80 times in the data collection and data analysis process to make sure my understanding of the app was consistent and comprehensive. I analyzed the data to study the app features through three different perspectives—app description, user reviews, and app content. I also constantly revisited my research questions and literature review to make sure the findings precisely answered the research questions and were consistent with previous research. These efforts improved the internal consistency of this study.

Third, Neuendorf (2017) stated that external dependability (often referring to generalizability) focuses on evaluating the representativeness of the data to determine whether the findings of the study are transferrable to other situations. I chose the three vocabulary learning apps to analyze in-depth from the most recommended apps list that resulted from a search of 20 resources that recommended language learning apps. These resources appeared to be reliable as they were also cited in other research on learning apps (e.g., Namukasa, 2016; Chik, 2014; Niño, 2015), in professional resources and journals (e.g., at *Center on Innovations in Learning*[9] website, in the *Professionally Speaking* Journal), by

[9] *Center on Innovation in Learning* is "one of 7 National Content Centers funded by the United States Department of Education supporting the 15 Regional Comprehensive Centers (RCCs) and the states they serve." See website http://www.centeril.org/

third party app analysts (e.g., App Annie), as well as in blogs and websites (e.g., Edutopia). These resources were accessible through Western University libraries and an online search. I reported clearly and in detail the data collection process, data analysis process, and results. This process could be replicated by other researchers who are interested in studying language apps.

4.6 Summary

In this chapter I presented the qualitative content analysis that I used in this study to explore the most commonly recommended affordable ESL learning apps, to study the app features of the selected vocabulary apps, and to suggest an app evaluation tool. I used a sampling approach to select representative data from a large quantity of apps. First, I selected a list of apps mentioned in previous studies, educational websites, journals, magazines, and blogs. From this list, I chose 20 learnings apps and 10 utility apps based on inclusion and exclusion criteria. I listed these 30 apps in Table 2. I then selected three vocabulary learning apps to be the sampling units for an in-depth analysis. I analyzed three recording units—app description, app content, and user reviews—to study the features of well-designed ESL apps. This content analysis was both inductive and deductive. I developed a data analysis diagram according to Elo and Kyngas's (2008) data analysis conceptual map to use as a guide for the three phases of data analysis which are preparation, organizing, and reporting. To explore the app features, I adopted a data analysis matrix from the preliminary app evaluation list. As I analyzed the data I generated new themes/subcategories such as learning topics and app support.

Chapter 5

5 Research Findings

Despite the pedagogical promise of language learning apps as an affordable and ubiquitous learning technology, it is a great challenge for teachers and learners to select from the multitude of apps developed by both educators and non-educators, apps that learners could use to meet specific language learning goals. As noted in the literature review, only a few studies provide evaluation tools for teachers to evaluate the quality of language learning apps. Teachers need lists of exemplar apps to select from when recommending language learning apps to parents, learners, and adult users. The purpose of this study was to explore the apps that are most commonly recommended for language learning, investigate features of exemplar and commonly recommended ESL learning apps, and develop an app evaluation tool that might inform selection of ESL learning apps for use in teaching or to recommend to parents and learners. I narrowed down the scope to apps available on both iTunes and Google Play app stores and looked in-depth at ESL vocabulary learning apps. I used Krashen's Theory as the theoretical framework. In this chapter I present my findings from the data analysis to answer the research questions:

1. What are the common ESL learning apps for mobile devices?
2. What are the exemplary features of ESL learning apps in terms of curriculum, pedagogy, and design?
3. What app evaluation tool could be used to assess the quality of ESL learning apps?

This is how the chapter is organized: In the first part I present the ESL learning apps that were most recommended by multiple third parties or mentioned in multiple resources for educators, teachers, and parents. I organized these apps according to the curriculum—specifically, the categories of language skills—that they focus on. In the second part I present my findings from my in-depth analysis of the features of three selected vocabulary apps—

Duolingo, *Johnny Grammar Word Challenge*, and *AnkiApp*. In the third part I present an evaluation checklist I initially developed from the literature review and then modified as I explored the most commonly recommended apps and performed the detailed analysis of the three selected apps.

5.1 The Most Commonly Recommended ESL Apps

As I showed in Table 2, I selected 20 learning apps and 10 utility apps from a total of 144 most commonly recommended apps available on both the iTunes and Google Play app stores because they met all the app inclusion criteria. The apps focused on different language learning skills including vocabulary, listening, reading, speaking, pronunciation, grammar, spelling, and comprehensive language learning. I also included a category for utility apps. Utility apps in this study are dictionary apps (e.g., *TheFreeDictionary.com-Farlex*, *Dictionary.com*, *American Wordspeller ESL*, *Wordreference*, *Dict CC*, *LEO*, *Pons*, *Linguee*) and translation apps (e.g., *Google Translate*; *iTranslate*). Although I chose not to recognize apps in the utility app category as learning apps in this study, several sites or magazines that recommend language learning apps include them as learning apps. Some apps appear in more than one category as they focus on more than one language learning skill. No apps that focused on writing skills were commonly recommended.

5.1.1 Vocabulary apps.

As Table 2 shows, there were four vocabulary learning apps in the app recommendation list. In the next section of this chapter, I will present in-depth analysis of three of the vocabulary learning apps—*Duolingo*, *Johnny Grammar Word Challenge*, and *AnkiApp*. *Phrasalstein* teaches phrasal verbs through animated stories. When the learner chooses a phrasal verb, the app will play the relevant animated story to express the meaning.

5.1.2 Listening apps.

I found four commonly recommended affordable listening apps—*EnglishCentral, Learn English Elementary (Podcast), LearnEnglish GREAT Videos,* and *Listening Drill*. The common feature of these apps is that they all provide learners with audio and/or video materials of everyday topics that are regularly updated to enhance learners' listening skills. Some of these apps contain unique features. First, all the apps except *Listening Drill* allow learners to access audio scripts in the learning process. Second, the listening materials in *Learn English Elementary (Podcast)* and *LearnEnglish GREAT Videos* are specific to British life and culture and have been recorded by native British English speakers. Third, *LearnEnglish GREAT Videos* is the only listening app in this category that contains a practice activity (i.e., comprehension questions). Fourth, *EnglishCentral* offers learning material to users with different learning purposes (e.g., academic, business, travel, media, etc.). Fifth, *Listening Drill* offers listening materials in English and other languages, and the app allows the users to upload their chosen video and audio.

5.1.3 Reading apps.

Three apps evinced features that could improve learners' reading comprehension because these apps incorporated learning materials such as conversations, dialogues, short articles, and stories. First, *Conversation English* provides conversations and quizzes that test learners' understanding. Second, *LingQ* appeared to offer learning opportunities for reading skills through dialogues, short articles, and stories. (see Appendix E for a detailed description of the *LingQ* content). As I discussed in Chapter 4, the in-app purchase price of the *LingQ* app after a one-week free trial exceeded $10 CAD. Even so, I included this app in Table 2 because few reading learning apps were recommended in the literature and in the app recommendation list in this study. The free trial provided the possibility for learners seeking a reading app to explore *LingQ*. Third, *The Cat in the Hat* is a reading app for ECE learners.

The app developers claim that they made this classic book fun and engaging by adding animations and embedded recordings. While reading, learners are able to interact with the device by tapping and dragging to find surprises throughout the book.

5.1.4 Speaking apps.

I included three speaking learning apps in the app recommendation checklist. *Hello Talk* and *Tandem* both offered language exchange opportunities for learners to connect with English native speakers to practice their speaking skills. In return, the ESL learners would teach their language partners the language they speak. *Conversation English* facilitates opportunities for learners to listen to conversations, practice through role play activities, and record their own speaking so as to enhance their conversation abilities.

5.1.5 Pronunciation apps.

This category includes apps with different pronunciation learning activities such as listening to recorded words and phrases, recording one's own words, teaching common everyday phrases, and teaching pronunciation of different words through phonemic scripts. I briefly describe four apps here. *Forvo* allows learners to search for and listen to pronunciations as well as to compare different accents in English and other languages. *Learn English Words & Phrases* teaches pronunciation of everyday sentences and phrases. *Sounds Right* and *Sounds-The Pronunciation App,* on the other hand, use phonemic script to teach pronunciation. Dictionary apps (e.g., *Dictionary.com, Google Translate, TheFreeDictionary*) often provide embedded word and sentence pronunciation.

5.1.6 Grammar apps.

I identified four apps with learning activities (e.g., quizzes, lessons, games, and explanations) that enhance learners' grammar skill. *Duolingo* and *Johnny Grammar Word Challenge* provide grammar practice activities through game-style lessons and quizzes. *Johnny Grammar Word Challenge* provides learners with timed 60-second quizzes in the

form of multiple choice questions that tests users' grammar knowledge, whereas *Duolingo* allows learners to learn grammar through activities such as translating, reading a sentence, word-sentence dictation, word matching, and answering multiple choice questions. *Grammar Up* consists of a grammar lecture section and a quiz section that assesses learning progress through multiple choice questions. *Learn English Grammar* provides grammar lectures, but there are no quizzes or practice activities in this app.

5.1.7 Spelling apps.

Johnny Grammar Word Challenge is the only app that provides learners with activities for practicing spelling. Learners practice spelling through timed 60-second quizzes with multiple choice questions.

5.1.8 Comprehensive language learning apps.

Three apps—*Duolingo*, *Johnny Grammar Word Challenge*, and *Conversation English*—teach more than one language skill.

5.1.9 Conclusion.

In brief, the most commonly recommended apps are designed for learning different learning skills, and some apps teach more than one language skill. Learning activities vary based on the language skill the app teaches. For example, listening apps mainly use audio and videos accompanied with audio scripts, whereas vocabulary and grammar apps mainly use lesson and quiz practices. Overall, the learning activities most commonly used in the apps were conventional quizzes and practice activities. The second most common activities were listening to prerecorded conversations, and lesson explanations. Learning activities unique to one particular app include games, dialogues, conversations stories, recording one's own speech and pronunciation, and getting in touch with native speakers for speaking and listening.

5.2 Features of the Selected Vocabulary Apps

In this section, I present a detailed analysis of the selected vocabulary learning apps: *Duolingo, Johnny Grammar Word Challenge,* and *AnkiApp*. I selected these apps from 20 resources that recommended apps on the basis of the inclusion criteria discussed in Chapter 4. I present the findings for each app in four parts:

1. A general app description from the iTunes app store (e.g., app description, version history)
2. An analysis of the app content through one researcher's experience when exploring the app
3. User reviews
4. Conclusion

The findings for the first three parts were presented with themes from the data analysis matrix. Some themes (e.g., learning topics, units, and lessons, placement test) were emerged during data coding. These themes were referred to as "app features" in this chapter and the discussion chapter (i.e., Chapter 6).

5.2.1 Duolingo.

5.2.1.1 General description in the iTunes app store.

App activities. Duolingo provides free language learning to users with different language needs[10], including language learning needs in English. The app developers described *Duolingo* as providing English learning experiences to learners through the following features:

a) mini-games that test the learners' reading, writing, speaking, listening, and conversations skills

[10] There are 23 languages available in Duolingo: English, French, Spanish, German, Italian, Portuguese, Russian, Irish, Dutch, Danish, Swedish, Turkish, Norwegian, Polish, Hebrew, Esperanto, Vietnamese, Ukrainian, Welsh, Greek, Hungarian, Romanian, and Swahili.

b) a language club where the learners can learn by competing with others

c) intelligent Chatbots with which the users may interact

d) personalized features such as tracking progress and earning rewards

User population. The app description claims that *Duolingo* has over two million learners and that it is the most popular app to learn a language.

Reviews. The iTunes app store editor describes Duolingo as a successful app. The editor owes the app's success to its genuinely fun learning process and its way of engaging learners in mini-games. In addition, journals and magazines, including international ones, give *Duolingo* highly positive comments. Here are some quotations from the app store:

"Far and away the best language-learning app." - *The Wall Street Journal*

"Duolingo may hold the secret to the future of education." - *Time Magazine*

Versions and updates. On average, *Duolingo* was updated on a weekly basis. The main reasons for updates, as indicated by the app store, were to fix bugs, improve performance, launch new languages, and add new functions. The users could access version history in the latest 6 months (25 items in total) in the app store.

Cost and paid functionality. Learning content from *Duolingo* is free, but there are in-app purchases (i.e., Duolingo Plus) available to have ads eliminated and access all lessons off-line. The app description showed that the cost ranges from $8.25 to $12.99 per month depending on the length of the subscription (e.g., 1 month, 6 months, 1 year). This feature is unique to *Duolingo*, and it does not exist in the app description for *Johnny Grammar Word Challenge* or *AnkiApp*.

5.2.1.2 Analysis of App Content.

In this sub-section I offer a detailed description of my experience exploring *Duolingo*. I describe the app form the perspective of a user.

Overview of the app options. *Duolingo* uses gamification in its learning design. Four icons at the bottom of each page help users navigate the app. The icons are labelled *Study*, *Health*, *Social*, and *Shop*. *Study* is the main page that presents learning components such as the learning units and the learner's accomplishments and rewards (e.g., how many consecutive days the learner has been studying, their level of fluency [%], experience points [XP], gem numbers, and the learning units) (see Figure 5). The *Health* page displays the learner's remaining health, which represents the number of mistakes the learner can make before the lesson is terminated. The *Social* page is the language club where learners can interact with each other. *Shop* is another in-app purchase function besides Duolingo Plus that provides users with various tools to extend the play time.

Figure 5. The main page in Duolingo. The icons at the bottom of this page from left to right are: Study, Health, Social, and Shop. I have superimposed the English translations of the Chinese instructions on this screenshots. This case applies to other screenshots with English translations in this section.

Duolingo users start learning a language by choosing their target language. In order to fulfill my purpose of studying *Duolingo* as an ESL learning app, I chose my native language, Chinese, as the interface language. On the registration page, I created my profile, including

my choice of user name, email address, and a password. Creating a profile allows users to unlock the language club, to freely access all the unlocked units, and to save learning progress and personalized settings (e.g., target language, daily learning goals) automatically on the device.

Learning topics, units, and lessons. This app feature was emerged from the data coding. There are 55 English learning units in Duolingo with over 150 lessons. Each lesson intends to teach different vocabulary. The title of each unit indicates that 21 units are designed for vocabulary learning, 31 units are for grammar, and 3 units teach basic English words and expressions (e.g., boy, woman, girl, hello, thanks). No rules indicate how the order of the units is listed in the app. For example, the fourth to the ninth units are 食物(food), 动物 (animals), 复数 (plural nouns), 所有格 (possessive nouns), 代词宾语 (object pronouns), and 着装(clothing) (see Figure 6). The app describes each unit as a "skill," and each unit contains from one to eight lessons. For example, the "Sport" unit has four lessons (see Figure 7). Each lesson has one summary page with a list of key words and ten learning pages on average. From my perspective as a user, the list of key words (see Figure 7), provides objectives for the learners. The user has to learn each lesson in sequence so as to progress and unlock the next lesson. Once a lesson has been unlocked, learners are able to practice the lesson as many times as they want. When the user answers a question incorrectly, the same question or similar questions show up again at the end of the lesson.

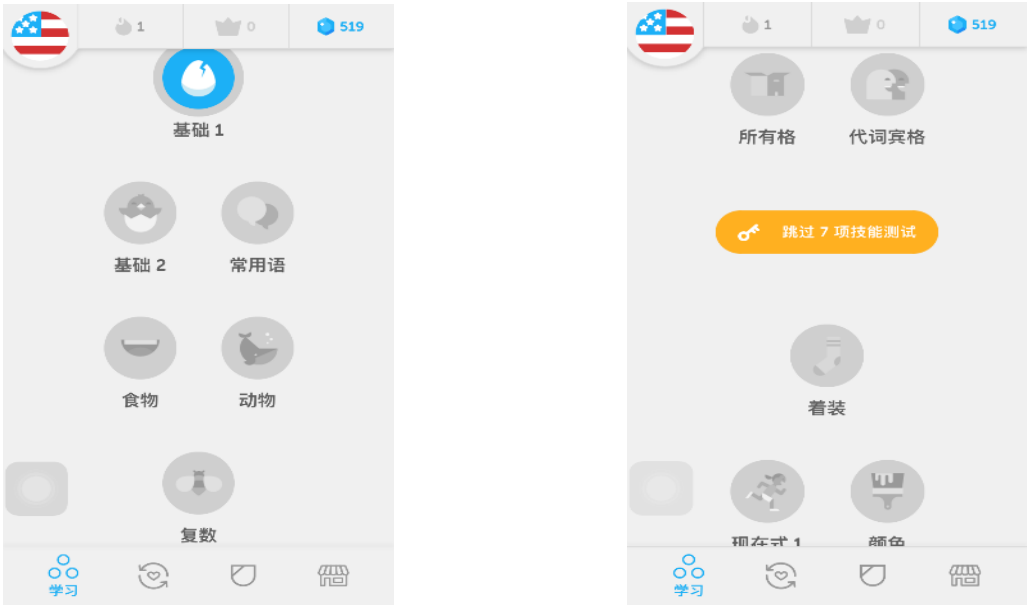

Figure 6. A sample of the learning units in Duolingo. From left to right and from top to bottom, the units are: (left screenshot) Basics 1, Basics 2, Expressions, Food, Animals, Plural nouns, (right screenshot) Possessive nouns, Object nouns, Clothing, Present Tense 1, and Colors.

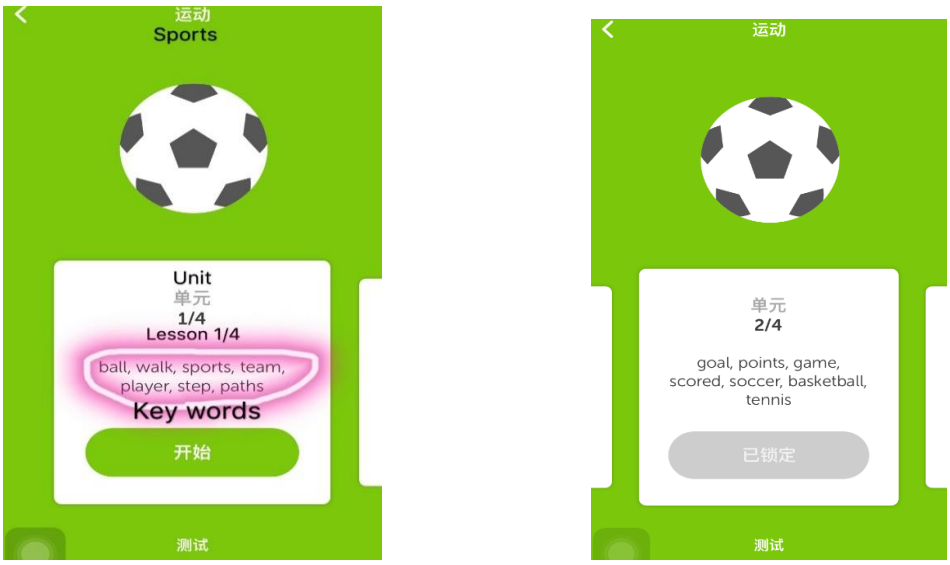

Figure 7. A sample of the “Sports” unit summary pages in Duolingo. The green icon “开始” in the left screenshot mean “start” and the grey icon “已锁定” in the right screenshot means “locked.” The user has to accomplish Lesson 1 in order to unlock Lesson 2.

Vocabulary learning activities—new words. There is no independent section in Duolingo that teaches learners new vocabulary before assigning learners the exercises for practice. All new vocabulary learning comes with exercises in the lessons. When a new word shows up for the first time, the word is underlined with dotted line, which the user can click to check its meaning. The app embeds pronunciation for each word; users click the word to access the pronunciation (see Figure 8).

Figure 8. Examples of learning activities in Duolingo. The screenshot on the left side shows an example of new word introduction and Chinese/English translation in Duolingo. The screenshot on the right sides shows an example of English/Chinese translation in Duolingo.

Vocabulary learning activities—translation and other forms of practice. The main method *Duolingo* uses to teach vocabulary is translation. In my choice of interface language, translation included English to Chinese and Chinese to English. Sometimes the app provides Chinese or English words for learners to choose from when forming a sentence (see Figure 8). In other cases, the app requires learners to translate a sentence into Chinese or English without providing choices of words in the other language, especially in simple sentences. For

example, Figure 8 shows a translation exercise that only presents the sentence in Chinese (i.e., “他展示它”), but there are no related English words (e.g., the words “shows,” “He,” “it”) for users to choose to form the sentence. Other forms of practice include multiple choice questions, reading a sentence, word-sentence dictation, word matching, and matching the meaning of sentences (see examples in Figure 9).

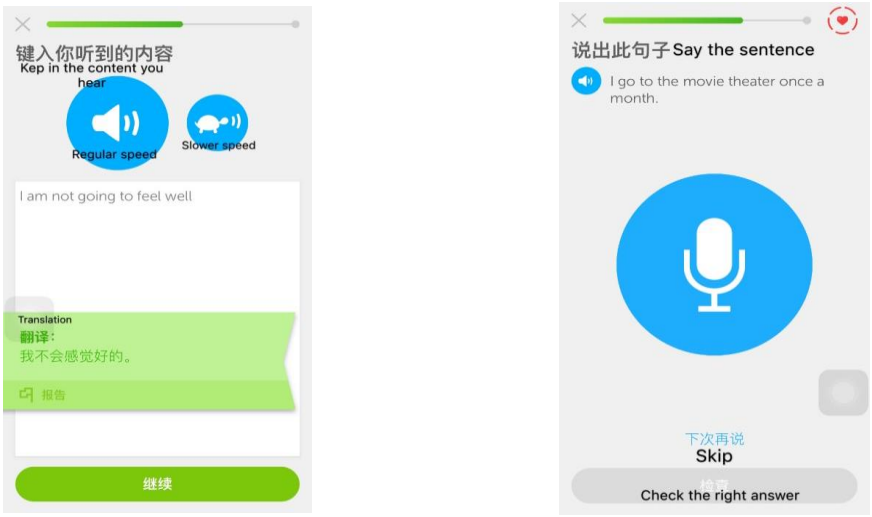

Figure 9. Some examples of the learning activities. The learning activities from left to right are word-sentence dictation, and reading a sentence.

Vocabulary learning activities—quizzes. A quiz section is available in each unit. Passing the quiz allows a user, whose vocabulary might be advanced, to progress to the next unit directly. In addition to *unit quizzes*, there are four *level quizzes* on the *Study* page that allow the user to skip several units and progress even faster (see Figure 10). In each unit that I completed, I found a section available showing my *weak words* that I did not do well on in previous practice. As I entered this section, I was provided quizzes to reinforce my memorization and understanding of these words.

Content accuracy. When I was exploring the English app content of *Duolingo*, I found one mistake, which is “if he walks, I walk.” This is a grammatical error in future tense, and the correct sentence should be “If he walks, I will walk.” When learners recognize

mistakes, they can use the “report” option in the feedback area to report the error.

Placement test. The app is tailored for users of different language levels by offering them choices either to start as a beginner or to take a placement test. A learner can only access the placement option when they start to learn a new language. (see Figure 11).

Figure 10. A level quiz to skip seven units in Duolingo.

Figure 11. Placement test in Duolingo. Learners can choose to start from the first lesson or to take a placement test.

Feedback on learning—textual corrections. The *Duolingo* app provides learners with instant feedback after answering each question. However, the feedback only provided one correct answer without extended explanations, and the app did not always recognize synonyms (e.g., *display* vs. *show*) in a response.

Feedback on learning—progress reports and reminders. As an active user of the *Duolingo* app, I received emails reporting my weekly study progress, encouraging me to start learning a new language, or introducing new app updates (see Figure 12). In addition, I would receive reminders on the phone screen when I did not accomplish my daily goal (The phone screen notification can be configured in the settings) (see Figure 13). It appears that the frequency of emails and screen notifications that the users usually receive depends on how

Figure 12. An email from Duolingo.

Figure 13. Notifications on the phone scree.

regularly they use the app. Feedback through progress reports and reminders is unique to *Duolingo* in this study.

Levels of difficulty. The *Duolingo* app only provided one level of difficulty, but in my experience it appeared that the levels of difficulty became more advanced as the lessons and units progressed. This is because each lesson introduces new words and uses more complex sentences. However, when I accessed the *Duolingo* app again about four weeks after I had finished data collection, the app had added Level 2 for each unit. The units were upgraded again to Level 3 eight weeks after the data collection (see Figure 14). In the next sub-section, users commented on levels of difficulty from the perspective of users' English proficiency.

Social aspects. Duolingo provides interactive opportunities for users mainly in two ways. First, users can compete with their friends on *Duolingo* through a leaderboard under the profile page. In order to use this function, users need to search their friends manually by user name or email address or invite their friends to use *Duolingo* through email or Facebook. The components shown in the leaderboard include the user names and their XP points. Second, there is an online community called "language club" where users can interact with others (see Figure 15). I explored this feature on an Android device because there were no clubs showing on the language club page on the iPhone device even when I received a

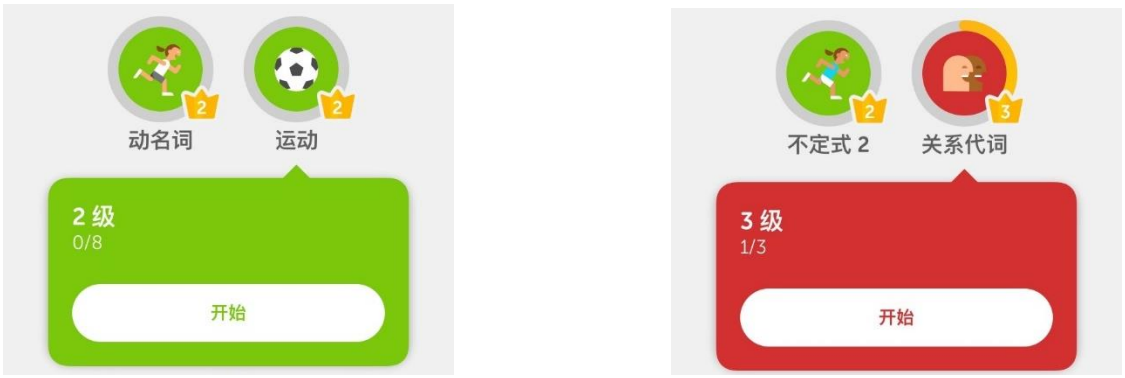

Figure 14. The upgraded levels of difficulty. The screenshot on the left shows Level 2 (2 级) of “Sport” (运动) and the screenshot on the right shows Level 3 (3 级) of “Relative pronouns” (关系代词).

Figure 15. The language club in Duolingo.

screen notification saying I had been accepted by some language clubs.

The interaction in a language club is limited to tracking team progress, communicating through customized emoji and phrases, and competing for leaderboard positions. With the app update, the language club page on the iPhone device was replaced by *Profile* four months after I collected the data for this study.

Classroom features. A “progress sharing” option is available under the profile page, which allows learners to share their progress with their classroom teachers. This function is in

connection with *Duolingo*'s school program[11], through which teachers can give assignments to students and monitor learners' progress on the dashboard. In order to share their progress on the app, students need to enter a 6-letter classroom code. This feature is unique to *Duolingo* in this study.

Gamification—health bar and gems. In the *Duolingo* app, each user has a "health bar." A user loses health with each mistake. Health runs out when the user has made five mistakes, and the health refill time is five hours for one piece of health, which means it takes a whole day to have a full health bar again (see Figure 16). In order to regain health faster, users can recover the health bar with gems or by practicing lessons they have already learned.

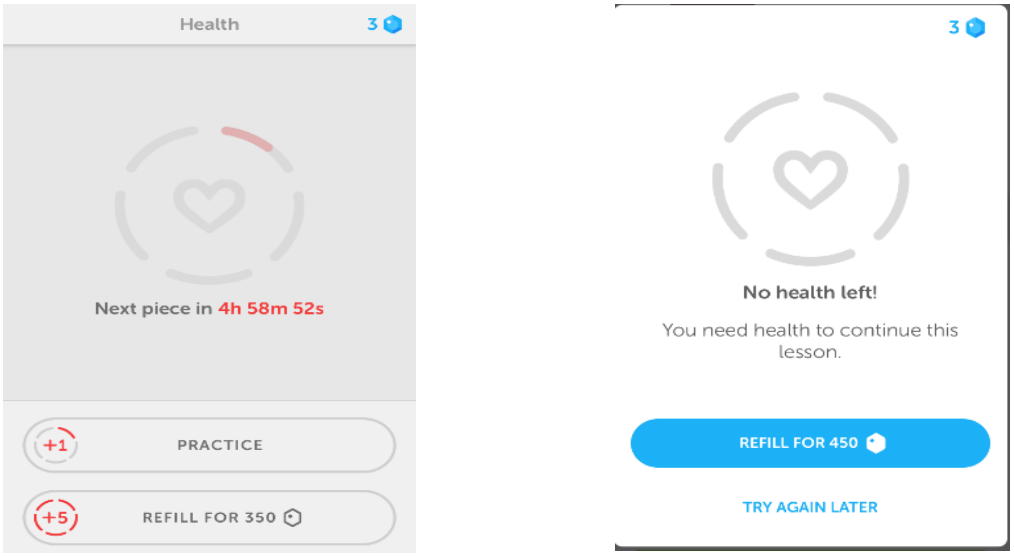

Figure 16. The Health function in *Duolingo*. At the top right corner of the screenshots are gem numbers the user owns. These two screenshots have English instructions because the screenshots were taken when using English to learn another language. These screenshots show the same instructions expect the differences of the language (e.g., Chinese, English).

Gem is the virtual currency in *Duolingo* that be used to purchase *power ups* tools to recover the user's learning status and extend learning time. Ways to earn gems include taking challenges and reaching daily goals. Users can purchase gems in the *Duolingo* shop with real

[11] The website for school *Duolingo* is: school.duolingo.com

money. The developers claim the purpose of gems is to "motivate and inspire learning in different ways (and allow more experienced users to adjust their own pacing)"[12]. Gems are not necessary to use the app because learners can choose to wait for the health bar to fill up by itself. As a learner, I found this feature did not help me make progress in learning; instead, I was afraid of making mistakes. This is because my lesson was immediately terminated when I made five mistakes, which disturbs my learning progress.

Gamification—rewards. Duolingo rewards users in three ways: XP, gems, and badges. One reward is to gain XP status, which—because a learner can move to the next level by accumulating XP—is the key to increase the learner's level. Learners can earn XP, such as the +2600 XP shown in Figure 17, for completing a lesson or a quiz. Dfferent levels require different points to progress to the next level. Usually, the higher the level, the more points that are required to move up. The app also rewards users with gems. When the users reach their daily goals, they have an opportunity to open one of the three treasure boxes that each contain a different number of gems, usually 10 to 20. If learners watch an ad afterwards, they are rewarded by opening a second treasure box. They can also earn gems by inviting friends. In addition to XP and gems, *Duolingo* users can earn badges by taking challenges and achieving various goals such as getting to the top of the leaderboard, finishing 20 lessons or practices without making mistakes, and earning 50 XP per day. These challenges are leveled up. When a user clicks on any one of the badges, the user will be informed of the next challenge to earn the higher level of the badge (see Figure 18).

Multimedia integration. Several media forms are integrated in *Duolingo*, including animated images (e.g., the "*Duolingo*" character, images to teach vocabulary), text (e.g., words, phrases, sentences), and audio. In my experience using the app were used to teach

[12] This information is retrieved from https://support.duolingo.com/hc/en-us/articles/115002860463-What-are-Gems-

new vocabulary. For instance, when the app teaches the word *woman*, it asks the question "which of these is a 'woman'?" in the user's chosen interface language (i.e., Chinese, in this study). At the same time, the screen presents four related animated images (e.g., a woman, a man, a girl, and a boy) with their respective English labels. The text is the used in different types of learning activities (e.g., translation, word matching, etc.). However, I observed that the speaking function was not sensitive enough to the accent of the speaker and to mispronunciations. One example is that when I intentionally mispronounced "the doctor" by saying "the water," the app recognized this as a correct pronunciation.

Off-line function. While all the lessons could be learned and practiced off-line, the quizzes were only accessible with an Internet connection in the free app version. The in-app

Figure 17. The XP in Duolingo

Figure 18. An example of earning gems

purchase included quizzes in the downloaded app. From my experience using the app, my learning progress was affected when I could not access the quiz off-line.

Pop-up elements. Ads cannot be turned off in the free version of *Duolingo*. When ads pop up it says on the page, "This ad helps keep education free." An ad popped up every time I finished a lesson. The ads are usually short, with an option for users to click "learn more" about the ad content if they are interested; otherwise, they can choose to ignore by clicking

on, “no, thanks.” From my perspective as a learner, these ads are distracting and create a high affective filter for me as a learner.

App support. The link labelled “sending feedback” is accessible under the profile page. User can click this link to send feedback or requests to the app developer. *Duolingo* also has an online help center[13] where users can access frequently asked questions and answers. This is an emergent feature from the data coding. As we shall see later in this section, all three apps have this feature.

App transactions—shop. The *shop* is the second in-app purchase component of the *Duolingo* app. In the shop users can use gems to purchase various tools to extend their learning time. Some examples of these tools are “health refill,” which allows the user to regain full health in no time, “health shield,” which allows the user to play for 30 minutes without health loss, and “streak freeze,” which allows users not to lose their place in the consecutive play days for a day of inactivity (see Figure 19). Users can purchase gems for prices from $2.79 CAD to $ 139.99 CAD for different quantities. These purchasable tools may be different on iPad and Android devices. From a perspective of a user, I did not make any purchase because it seemed to be unnecessary to me. This feature is unique to *Duolingo* in this study.

In conclusion, *Duolingo* is a freemium app. Unlike other freemium apps that provide only a limited amount of free content, the content in *Duolingo* is completely free. The freemium feature is to remove ads and gain full access to the off-line function, as well as to access the purchase tools for gems in the shop with real-life as opposed to virtual money. *Duolingo* contains 21 units with different topics are designed for vocabulary learning. The learning activities include lessons and quizzes mainly in the forms of translation, multiple choice questions, word-sentence dictation, and word matching. Other app features include

[13] The website for Duolingo online help center is https://support.duolingo.com/hc/en-us.

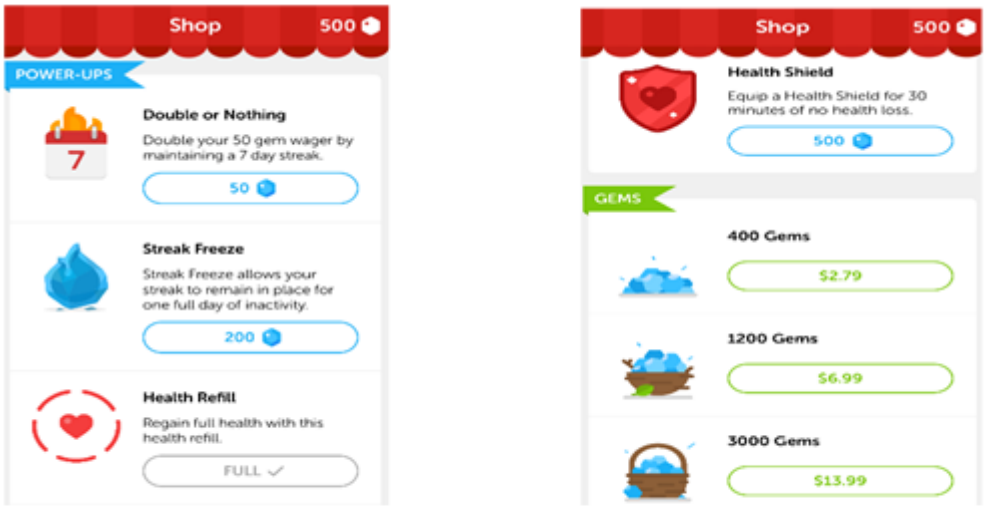

Figure 19. The shop in *Duolingo*.

multimedia integration, progress reports and reminders from the app, feedback with textual corrections, a language club and a leaderboard, gamification elements (e.g., health bar, gems, XP, etc.), and pop-up ads. Three app features—placement test, classroom features, and app transactions—are unique to *Duolingo*. These features do not exist in *Johnny Grammar World Challenge* and *AnkiApp*; for this reason, I did not list these three features for those two apps.

5.2.1.3 User Reviews.

In this sub-section I present user reviews of the *Duolingo* app. I begin with general information to introduce the app ratings, number of the reviewed comments, and the sources of the user reviews. I then present the findings according to the themes from the data analysis matrix in Chapter 4. More themes (also called "app features", as I mentioned earlier in this section) (e.g., personalized learning, technical elements), emerged from my study of the user reviews.

I assume that the reviews that apply to other languages are likely also to apply to English because the app is designed by the same company using similar features. In my examination of the reviews, I was nonetheless attentive to reviews that appeared to apply to English or to vary with interface languages users may have selected.

By March 5, 2018, there were altogether 17775 user ratings for *Duolingo* in the iTunes app store. *Duolingo* was marked as a four plus (4+ out of 5) star app, but the overall rating was not specified. In my experience, the iTunes app store does not specify the overall rating for any apps, including *Johnny Grammar Word Challenge* and *AnkiApp*. Therefore, I also accessed the *Duolingo* description page in the Google Play app store. There, *Duolingo* was rated 4.7/5. Of the user reviews I studied, I focused on reviews related to English vocabulary learning and some general comments such as social interaction and app support.

Overview of the app's effectiveness. Most users (about 83%) considered *Duolingo* to be an effective language learning app because they could learn through playing different games and activities, which they commented were fun and easy to use. Some users described the games as having an addictive inclination. One of the app supporters commented "Everything is being retained so much easier than when in school."

Users commented that they liked the way lessons were designed in *Duolingo*. They mentioned, for example, the practice of earning rewards and of allowing learners to access lessons unlimited times. They claimed that they were able to review the lessons repeatedly to solidify their learning. At least 15 users mentioned in their written reviews that *Duolingo* was helpful for beginners because they improved quickly through practice, and the app covered all basic vocabulary (e.g., mum, dad, love, etc.). It appears to me that these users may have a low affective filter when using *Duolingo*, and that the learning activities have the potential to increase their comprehensible input.

Enhancing vocabulary. The majority of users expressed that *Duolingo* helped improve their language skills, and five of them explicated that their vocabulary was enhanced using *Duolingo*. One user commented, "assimilation of vocabulary, declensions and declinations is achieved almost unconsciously. Excellent!"

Pedagogical appropriateness. Users who reviewed the app also mentioned that they found the pedagogy in *Duolingo* to be advanced, noting that the app engaged the users through both challenges and encouragement, which made the learning process fun. One user commented that, "the methods of teaching are great, speaking, translating, pairing words." *Duolingo* allowed learners to develop other language skills simultaneously while they practiced the vocabulary units. One example is, "not only does it guide you through recognizing and memorizing vocabulary in a fun way, it also had us practice listening and speaking. I found this to be very practical." Even so, some reviewers indicated that it is not enough to learn only through practice. They found the app content challenging for learners who had no foundation of English because there was no independent lesson explanation before practicing in *Duolingo*. All vocabulary was learned through practice, and, as a result, sometimes learners had to guess the meaning of advanced words they had not yet learned.

Feedback on learning. Overall, users appeared to be unsatisfied with the feedback in *Duolingo*. Although immediate feedback was available when users were taking lessons in *Duolingo*, 10 users noted that the feedback was insufficient because *Duolingo* only provided one textual correction without giving extended explanations of the language rules the app tries to teach. It also failed to consider synonyms. This limitation, according to the users, made it difficult for them to address their mistakes and to follow the lessons as the lessons progressed.

Levels of difficulty. Users commented on the levels of difficulty of the *Duolingo* app content from the perspective of the learner's English proficiency. One comment opined, "If I didn't already know a little of the language, I think it would be very difficult." Other users, on the contrary or perhaps referring to much more advanced vocabulary or more sophisticated language skills, argued that *Duolingo* is not designed for users who desire

advanced English learning. One user commented that "*Duolingo* does a very good job, but I wish there was more in-depth learning."

Social aspects. Although six users acknowledged the usefulness of the interactive features of *Duolingo*, one user argued that more interaction should be added: "I really want there be competitions *[sic]* with your friends. That would be really fun!!" Although there is a leaderboard on the profile page where users can compete with friends, perhaps the users who commented on opportunities to compete with friends were looking for more engaging ways such as practicing a lesson simultaneously with acquaintances and getting immediate feedback about the competition. I did not find any comments in the user reviews about the *Duolingo* language club, which is another interactive element.

Some users indicated that *Duolingo* should improve its social context because some phrases and sentences are "weird" and do not make sense in real life. The users did not provide an example for this situation. I assume my experience in the Chinese/ English translation practices fall in the category what the users means as "weird": (a) 明天, 周五晚上 (Tomorrow, Friday night.) (b) 她的周日是个人的 (Her Sunday is personal. —为什么？ —因为！(-Why? -Because!). These translations are not expressions or sentences that we commonly use in Chinese or English because these sentences do not convey complete meanings outside of a specific context.

Gamification appropriateness. Only a few users appeared to understand the role of the health bar. These users explained that the app had to make money through the health bar even though they did not like it. Almost half of the users who ranked the app with 3 stars or fewer claimed that the health bar was the major reason that they were not satisfied with the *Duolingo* app. These users were likely to refer to the feature of the upper limit of five mistakes after which a user had to wait for a long time until they could study again. It seems that these users were not interested in the other options—practicing the learned lessons to

earn health points or purchasing gems to recharge their *Duolingo* health. Perhaps they considered it to be too time-consuming to practice knowledge they already learned over and over again or too expensive to make the purchase. Selected user reviews related to the inconvenience of the health bar are, “I don’t like the health thing. I have to sit all day and wait. This is bad” and, “Really hate the health circle. I’m trying to learn, so of course I’m going to make mistakes. Now I can’t finish a lesson and I have to go back and review a topic that has nothing to do with the mistakes I made and then try to go back and get through the lesson without 5 mistakes.” From the users’ comments, it seems that the health bar has created an uncomfortable learning environment for some learners.

Autonomous learning. About 10% of the users noted that the activities in *Duolingo* were practical and helpful for learning vocabulary because these activities engaged and motivated them to use the app regularly, allowing them to build up their knowledge on a daily basis. Certain users, however, noted that the long recovery time for the health bar discouraged them from using the app.

Personalized learning. Many users commented that the app was personalized. Ten users said the learning was tailored to the user’s own proficiency through a placement test at the beginning, and learners could learn at their own pace by practicing a lesson as many times as they wanted.

Multimedia integration. Some users commented on the use of multiple forms of media (e.g., audible recordings, pictures, written texts) in the *Duolingo* app as being very helpful. The media elements supported lesson practice in the forms of translation, text-to-speech (e.g., reading a sentence), and speech-to-text (e.g., word-sentence dictation) activities, to name a few. One comment illustrating this view is that, “Uses multiple methods to help you understand—audible recordings so you can hear the words, pictures so you can associate the sounds/written with the item described, and of course written as well. Very cool that it

ALSO records you speaking." However, about five users complained about media problems they encountered such as the microphone not working and the voice recording not recognizing the users' pronunciation.

Off-line function. Four users found it annoying that there was only a limited off-line option. Although the lessons could be learned anytime and anywhere, these users felt it inconvenient not to be able to do quizzes offline.

Pop-up element. On top of health bar constraint, some user reviews were about the distracting nature of the ads. They explained that this affected their learning efficiency. Users mentioned they felt frustrated with the ads and described the *Duolingo* app as "money maker" and "money grab."

App support. Some users noted that the *Duolingo* app should add more question types and quizzes. Users also requested more comprehensive feedback. They suggested that the accuracy of the text-to-speech and speech-to-text functions could be improved.

Technical elements. Another issue that bothered many users was technical problems. About 60 people (about 10% of the selected users) expressed that the app had judged their right answers wrong. Occasionally, no right answer was given in the options, and the user had to choose one of the wrong answers to progress to next question, which caused loss of Duolingo health. I did not have this experience when I played with the app to study English using a Chinese interface language. It is possible that these users' feedback applied to their experience of *Duolingo* when studying English using another language (e.g., French, German) interface or when learning other languages. Some comments mentioned that the text-to-speech and speech-to-text functions were not always accurate. Some users pointed out that, "apparently the microphone has not worked on this app for years as other reviews also complain about that."

In conclusion, from the number of user ratings, *Duolingo* appears to be widely used. More than three quarters of *Duolingo* users claimed that this game-style learning app was fun and easy to use. Some users reported that the incorporation of multimedia enhanced their vocabulary and other language skills. Other users commented on the personalized app features such as the placement test and the individualized learning pace. However, users also pointed out that the feedback is not detailed enough, the learning content lacked contextual relevance, the health bar limited learning opportunities, and ads were distracting. As well the users had different opinions on the levels of difficulty the app content; some said the app is for beginners, while others considered it too advanced as no lesson explanations were provided prior to the practice.

5.2.1.4 Summary.

In this section I presented an in-depth analysis of the *Duolingo* app, covering the app description in the iTunes app store, the app content as I experienced it, and user reviews that are publicly available at the iTunes and/or Google Play stores.

Duolingo app description. The app description presented general information about the app from the developer's perspective. The description includes the main app activities, user population, third party reviews, the app version history, and the paid functionality. *Duolingo* is regularly updated and some updates such as fixing bugs and adding language appear to be in response to user reviews. The developers assert that the cost of the app is for the purpose of removing ads, accessing all content off-line, and purchasing gems, yet not all in-app purchase options in the *shop* are listed in the app description. Meanwhile, the app description did not highlight vocabulary and grammar as the main language skills *Duolingo* provides. Yet, from my experience exploring the app, the topics of the units focus on vocabulary and grammar skills; users can also practice other skills (e.g., reading, writing, pronunciation) through practice activities in the lessons and quizzes.

Duolingo app content. In the app content section, I presented a detailed description of my experience exploring the app. Overall, my app content analysis revealed the following quality, productive, and well-designed features:

a) Curriculum: There are 55 units with over 150 lessons, key words in each lesson, and various content activities (e.g., lessons, and quizzes) in each unit.

b) Pedagogy: Detailed lesson content is presented in the form of units that include learning activities such as translating, word matching, reading and recording sentences, a language club and a leaderboard, and immediate feedback. The app presents vocabulary content through game-style activities and learning rewards (e.g., gems, XP). The app also provides connections to classroom assignments.

c) Design: The app makes purposeful use of images, animation, texts, and audio. It includes a personal profile page, saved progress, personal progress reports and reminders, and a *sending feedback* link. The app is updated regularly and support is available.

Some features of *Duolingo* need improvement. *Duolingo* does not provide an independent lesson section to teach learners new vocabulary ahead of the exercises for practice. Feedback on lessons is not detailed, and this may become an obstacle in the learning practice. Whereas the animated images used in the lessons were derived from everyday life and so have the potential to connect users with their everyday life experience, there is no more obvious evidence that *Duolingo* is contextual, especially when the sentence expressions are not authentic and are not commonly used in both English and the user's native language. *Duolingo* does not appear to recognize subtle differences in learner pronunciations. Some elements in the in-app purchases were costly. The off-line function did not provide users with full access to lessons and quizzes.

Duolingo user reviews. Over 80% users stated that *Duolingo* has some productive and well-designed features. On the pedagogy of the app, learners commented on the opportunity to have unlimited access to review learned lessons. The personalized functions allowed the users to learn at their own pace and they found the learning activities to be both challenging and motivational. These features promoted autonomous learning and enhanced their vocabulary. On the design of the app, they commented on the good use of multimedia. Even so, some users pointed out limitations of *Duolingo*:

1. Regarding pedagogy, users commented on lesson feedback that lacked detailed explanations.
2. Users also suggested that *Duolingo* should add levels of difficulty and improve the quality of media. The app developer appears to be supportive of the users' requests because they updated the levels of some units and fixed bugs that were mentioned in the comments.
3. Users disliked most the health bar, commenting that it limited their progress as they needed to wait for a long recovery time after making five mistakes. Some users commented that this discouraged them from making mistakes, which hurt their motivation and lowered their learning efficiency.
4. Regarding app design, frequent ads disturbed learners' progress through a lesson.
5. Limited off-line function made the quizzes inaccessible for learners when and where there was no Internet connection.

In conclusion, given the numerous reviews, *Duolingo* appears to be a widely-used English vocabulary learning app. The app has many well-designed features for learning vocabulary. *Duolingo* supports its learners through regular app updates. Even so, the user reviews revealed that several improvements are needed, especially on the features that serve

commercial purposes for the designers but also distract users' learning or delay progress through the lessons. Table 4 summarizes the app features of *Duolingo*.

Table 4

Duolingo Summary Table

Category	**Quality, Well-designed, and Productive features**	**Features that need improvement**
Curriculum • Learning content are provided or not • Topics • Objectives • Accuracy • Content Activities	• Learning content are provided • 55 units/topics, 21 vocabulary units and 34 other language skills • Key words • Lessons, quizzes	• Grammar mistake in a sentence
Pedagogy • Learning activities • Levels of difficulty • Assessment and feedback • Gamification • Personalized learning • Autonomous learning • Social aspects • Interactions • Contexts	• Translating, word matching, reading and recording sentences, word-sentence dictation for practice • Improves other language skills on top of learning vocabulary • One level, and lesson becomes more advanced as the learners progress • Health bar, rewards (e.g., gems, XP, badges) • Personal profile page to save progress, access language club and unlocked units • Personalized progress reports and reminders through email and phone screen notification • Placement test, quizzes to unlock units • Promotes self-directed learning • Learned lessons can be accessed unlimitedly • Uses pictures related to everyday life • Leaderboard: see the rank among friends • Language club: need approval or even invitation code to join a club	• No independent lesson explanations • No synonyms or detailed explanations in the feedback • Need to add questions types and levels of difficulty • Levels of difficulty not clearly defined • Long recovery time for the health bar discourages motivation • Some sentences do not make sense • No interaction beyond friends who are added as a friend • No interaction among learners for learning collaboration purposes
App Design • Multimedia • Online/offline	• Uses text, animation, audio, and images in the lessons and quizzes	• Voice recording is not sensitive to mispronunciation

Category	**Quality, Well-designed, and Productive features**	**Features that need improvement**
• In-device and online support • Interface languages • Technical errors • Ads • App Transactions • In-app purchases • Shop	• Lessons are accessible without Internet • Send feedback or requests through the link "Sending Feedback" in the app • Online help center for Q&A • Choice of over 30 languages, including English • Remove ads and access quizzes off-line • Prolong play time when purchasing tools with gems	Quizzes are not accessible in the free version • Technical errors (e.g., do not recognize the correct answer; content of speech-to-text and text-to-speech is sometimes inaccurate) Ads pop up after each lesson • Expensive purchases for seemingly unnecessary elements (e.g., power ups)
General App Description • Style • Version and updates • Ratings and number of users • Stand-alone or app in a suite of apps	• A game-style design with rewards and punishment • 4+ out of 5 rating in the iTunes and 4.7 out of 5 rating in Google Play • 17775 (iTunes) rating (number of reviews not stated) • More than 2 million users worldwide • 83% user satisfaction • Latest version at date of data analysis was March 2018 • Weekly updates on average • App in a suite of apps for knowledge content • Total number of users not stated	

5.2.2 Johnny Grammar Word Challenge.

5.2.2.1 General description in the iTunes app store.

App activities. Johnny Grammar Word Challenge is a free English learning app that is designed with learning activities in vocabulary, grammar, and spelling. The app teaches users everyday English through several timed 60-second quizzes. The quizzes require learners to distinguish daily used phrases such as “in time” and “on time” and learn authentic English expressions. The app developer has highlighted these features:

a) Three levels of difficulty: Easy, Medium and Hard

b) Word, Grammar, and Spelling are the categories users can choose to practice.

c) Ten topics are included in the learning activities (e.g., Food and Restaurant, Travel, Idioms, and Hobbies)

d) Learners can earn badges as they make progress

e) Learners can share scores and compete with others on the leaderboard

f) Learners received feedback for wrong answers so they know the cause of the error

User population. The description claims the app has 130,000 users all over the world.

Reviews. The developer did not provide reviews from editors, third parties, or others.

Versions and updates. The app was released in May 2011 and there were 15 versions in total by March 3, 2018. The last update was version 3.4 with the purpose of providing full support to iOS 11 and iPhone X and making some improvements (i.e., fixing bugs). The update frequency ranged from two months to a year.

Cost and paid functionality. This app does not have this feature.

5.2.2.2 Analysis of app content.

In this sub-section I provide a detailed description of my experience exploring the content of *Johnny Grammar Word Challenge*. Besides the themes in the data analysis matrix as the app features, *Johnny Grammar Word Challenge* also have some emergent app features

the same as *Duolingo* such as learning topics, lessons, and units, feedback on learning—textual correction, and app support.

Overview of the app options. *Johnny Grammar Word Challenge* starts with an ad that can be turned off after 5 seconds. Subsequently, the user is provided options to log into the system in three ways: log in (or register) their own account, log in through Facebook, or play as a guest (see Figure 20).

On the main page, users can use five options to navigate the app. *Play* (or *play as a guest*) takes the user to three different quiz categories: Grammar, Words, and Spelling (see Figure 21). *My Badges* shows the user's learning achievements. The app does not explain what tasks the user should complete in order to obtain these badges (see Figure 22).

Figure 20. The main page in Johnny Grammar Word Challenge.

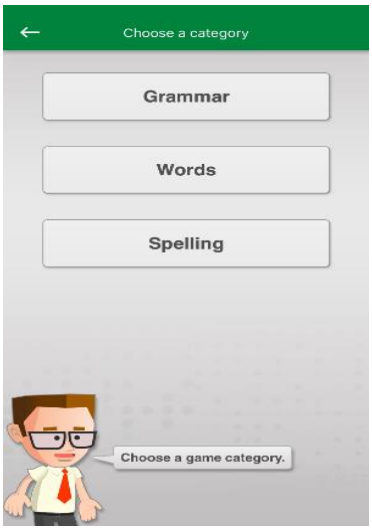

Figure 21. The learning categories in Johnny Grammar Word Challenge.

Leaderboard is a ranking list that shows scores of the top 100 players in three different categories with three levels of difficulty including Words Easy, Words Medium, and Words Hard (see Figure 23). *Settings* allows the users to change interface language among English, Japanese, and Spanish. *About* provides information such as the app version, more download recommendations, and promotion of the app social media.

Figure 22. A sample My Badges page in Johnny Grammar Word Challenge.

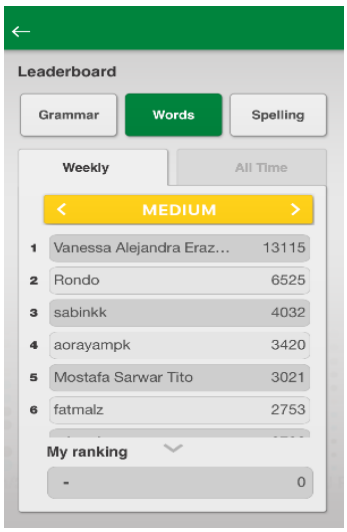

Figure 23. The Leaderboard page in *Johnny* Grammar Word Challenge.

The app saves learners' earned badges and interface language on the device even when the learner does not have a profile. However, learners' progress in quizzes is not saved.

Learning topics, units, and lessons. In the *Johnny Grammar Word Challenge* app, the vocabulary category is labelled *Words.* I chose specifically to study the *Words* Category, which includes ten units. Each unit has a topic, including *Food & Restaurant, Travel & Getting ting Around, Small Talk, Hobbies, Idioms, Express Yourself, Films, TV, Internet, At Work, Taking it Easy,* and *Shopping.* There are three quizzes in each unit.

Vocabulary learning activities—new words. Johnny Grammar Word Challenge does not provide an independent section to explain new vocabulary, nor does it provide word translation in the quizzes. It appears that the app designers expect users to have a certain amount of English vocabulary because the quizzes test learners' knowledge of daily used words, phrases, and authentic expressions rather than teaching new vocabulary. For example, a question in *Travel & Getting around* is, "Where do you wait to get the train?" Four response options are given: stage, standing, platform, counter. None of the words in the question and answer options are explained before learners encounter the quiz.

Vocabulary learning activities—quizzes. The learning activity in this app is quizzes. For each quiz, the user has 60 seconds to answer as many multiple choice questions as possible with a maximum of 15 seconds for each question (see Figure 24). The users can get up to five points when correctly answering a question, depending on the length of time the user takes to answer each question. Users lose 2 points if the answer is wrong. Lessons in all levels can be accessed unlimited times. Users do not need to finish one lesson in order to access the next one. For each topic, there is a limited number of questions (about 20 questions) in each quiz, which means learners may answer the same questions more than once if they answer more than 20 questions during the 60-second quiz time.

Content accuracy. I did not identify any mistakes or errors in the content of the Word category in Jonny Grammar Word Challenge.

Feedback on learning—textual corrections. The user receives feedback after the 60-second timer finishes. The feedback includes the number of questions answered, number of correct answers, total score earned, and the correct answer for each question. However, no detailed explanation for a wrong answer is provided (see Figure 25).

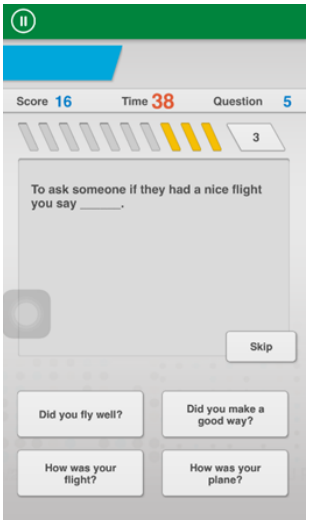

Figure 24. The 60-second quiz in *Johnny Grammar Word Challenge*.

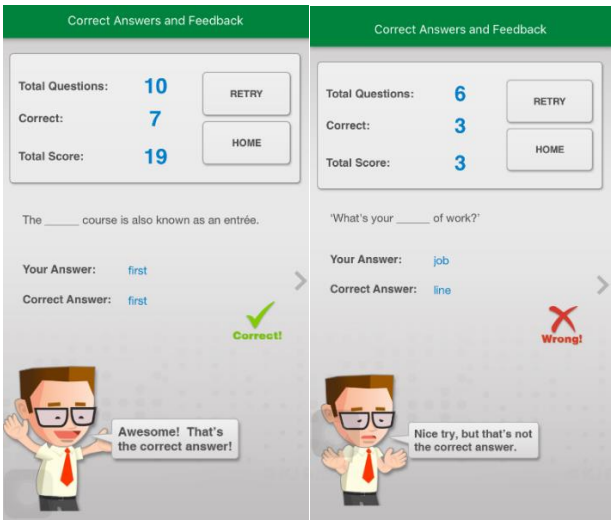

Figure 25. The answers and feedback page in *Johnny Grammar Word Challenge*.

Levels of difficulty. Each topic has three levels of difficulty—easy, medium, and hard—for users to choose according to their English proficiency. Nevertheless, the app developer did not explain the level of language proficiency that relates to each of the three levels of difficulty.

Social aspects. The only online interaction element found in *Johnny Grammar Word Challenge* is the *Leaderboard*, where the user has an opportunity to compete with other players through a ranking list (see Figure 23). The *Leaderboard* does not allow users to communicate with each other by sending messages or posting and answering questions. The app was developed by the British Council so some words, phrases, and expressions in the quizzes are expressed in British English. For example, the medium level lesson of the *Travel & Getting Around* section makes reference to an *underground train* ticket (British English) instead of a *subway* (American English). One question asks the correct expression for starting a conversation, and the answer is "Lovely day, isn't it!" This is also more often used in British English. Even so, some expressions (e.g., How's it going?) are common in both British English and American English.

Gamification. *Johnny Grammar Word Challenge* has the following gamification elements: the Leaderboard, which allows competition, My Badges, which provides rewards, and the timed quizzes.

Multimedia integration. Johnny Grammar Word Challenge uses text in the quizzes and animation (e.g., the "Johnny" character) as instructions. No pictures or sound effects (e.g., audio recordings, microphone function) are used in the quizzes.

Off-line function. Functions such as quizzes, feedback, and *Settings* in *Johnny Grammar Word Challenge* can be used off-line, whereas *My Badges* and *Leaderboard* require an Internet connection to run. The latter two functions, according to my experience as a user, did not appear to affect the efficiency of learning.

Pop-up element. Ads pop up every time the users access the app. Sometimes ads also show up when the users finish a quiz.

App support. The link labelled "support & feedback" in *About* takes the users to an email page where they can send feedback or requests to the app developers.

In conclusion, *Johnny Grammar Word Challenge* is a free app that offers English vocabulary learning through several 60-second quizzes. Ten topics are included in the practice with three levels of difficulty in each quiz. All the quizzes are accessible off-line. The app incorporates some multimedia elements and provides textual corrections after each quiz. However, there are no detailed explanations. Other app features include a leaderboard, badges as practice rewards, use of British English, and pop-up ads. One feature unique to this app is the social context—British English expressions. The other two vocabulary apps do not indicate the region of the language (e.g., British English or American English).

5.2.2.3 User reviews.

In this sub-section I present the user reviews of *Johnny Grammar Word Challenge*. I start with general information, including the app ratings, number of reviewed comments, and the sources of the user reviews. Emergent themes (or "app features") are examination preparation and age group.

There were 176 ratings with 15 users reviews for the app in the iTunes app store by March 5, 2018. Like *Duolingo*, *Johnny Grammar Word Challenge* was marked as a four plus (4+ out of 5) star app in the iTunes store, and the overall rating for the *Johnny Grammar Word Challenge* app in the Google Play store was 4.4/5. This result is based on 22936 users' ratings. Compared with *Duolingo* user reviews, the users of this app commented on the learners' age group features that are unique to *Johnny Grammar Word Challenge*. The users did not comment on autonomous learning, personalized learning, the social aspect and the off-line function of this app.

Overview of the app's effectiveness. About 84% users claimed that *Johnny Grammar Word Challenge* is an excellent English learning app. They noted that the timed 60-second game-style quizzes were fun, engaging, and educational. They noted there were interesting topics (e.g., small talk, hobbies, idioms) for learners to choose from. Some users commented that the quizzes were easy to navigate even without instructions.

Enhancing vocabulary. 153 users (about 26% of the selected reviewers) stated that the app is practical and that it helped them improve their English competency, especially in vocabulary. One user wrote that "this game is great to learn British council [*sic*] and I learn many words to gain my vocabulary and I learn some words be [*sic*] a different meaning in other contexts." Another user shared his experience of learning some colloquial phrases.

Exam preparation. Another feature emerged that from the user reviews was the potential of the app in helping students prepare for their exams. At least nine users pointed out that they used *Johnny Grammar Word Challenge* for exam and test preparation (e.g., IELTS). They appeared to be very excited about the effectiveness of the app. They left comments such as, "it helped me a llllooooooot foooor mmmmyyyy exxxxaaams [*sic*]," "amazing game to teach me more about English language especially for my dream in IELTS exam," and "best app for exam preparation."

Age group. The British Council on its website describes the app as suitable for 8-year-old children and up[14], but there were different voices about the most appropriate age group for the app. Generally, users tended to think it is more suitable for children. One parent wrote "my 7 yr old enjoys playing while learning English" and another user commented "Its [*sic*] good for kids to learn English at home at their beginning years of education." In contrast, one user considered the app unattractive to young learners because it does not use graphics. A

[14]This information is available on https://www.britishcouncil.org/english/children/apps/word-challenge.

third user voiced that the app suits all ages: “nice app for all ages who want to correct themselves.”

Pedagogical appropriateness. Each lesson in *Johnny Grammar Word Challenge* is presented in the form of quizzes. Some users said this feature helped them recall their prior knowledge. On the other hand, a few users found it challenging to take the quizzes without an independent lesson explanation section to learn the vocabulary prior to taking the quizzes. The learners claimed the limited number of questions in each quiz resulted in frequently repeated questions. Other comments related to pedagogy were: “this is helping. but I hope the exercise would be [*sic*] more variety,” and “overall, a good app for practice. Will definitely help kids. Still, the difficulty level and variety in sentence can be added.”

Feedback on learning. Seven users expressed their dissatisfaction that the app only provided a correct answer for each question with no extended explanations when the answer was wrong. The users noted that they were looking forward to updates with more detailed feedback. One user said, “it would be more helpful if this app has explanations for the answers. Especially [the] incorrect [answers].”

Levels of difficulty. Users had different opinions on the level of users’ English proficiency the app is designed for. Some users thought it to be suitable for beginners. One user commented, “that's a great app for beginner[s] like me to learn English.” Other users found the app difficult and more appropriate for advanced learners, noting that there was no explanation for the questions. Finally, one user said it was a “superb application for intermediate knowledge of English.”

Autonomous learning. Users noted that this app made learning fun without pressure. It felt like “playing a game rather than learning something.” As a result, their learning experience with *Johnny Grammar Word Challenge* increased their confidence in learning English. Users noted that the app encouraged self-directed learning by allowing learners to

enjoy learning anywhere such as “when taking the bus,” “during the tea time,” and “when at home.” Users also found the app informative in teaching English expressions and culture and said that it was suitable for ESL learners of all levels. According to users, the app is a “skill enhancer.” They learned a lot in a short time using the app.

Gamification appropriateness. Some users responded that they liked the game-style of the app, while others did not. Specifically, 14 users were unsatisfied with the time limit, explaining that 60 seconds was not enough time to read the questions and understand the answer options, which restrained their efficiency in learning new words and practicing of learned vocabulary. Some users suggested that the app designers disable the time limit or make the time length and pace adjustable so they could learn at their own pace. An example of the user comments with regard to this matter is, “it moves very early when thinking [*sic*] the answer. There would be a button for the pause timer those who don't want it. This application is most useful for me. Thanks a lot for your precious efforts.” However, not all users disliked the time limit. One learner commented that the 60-second quizzes are beneficial for learners who are preparing for exams because it pushes the learner to answer the questions quickly as they do in exams.

Multimedia integration. Several users commented that there were mainly text in the learning content. They recommended that the app developers should add graphics and sound effects (e.g., pronunciations, music).

Pop-up elements. Although ads seemed not to bother most users, eight users (about 1.3%) expressed their dissatisfaction with in-app advertisements. They left comments like, “it’s a good app with nice challenging words, please remove the ads, it’s bothering” and “severely dissatisfied with ads and notification.”

App support. In addition to the updates the app provided to fix bugs, improve the app operation speed, and so forth, users hoped to have more frequent updates including adding

profile details (e.g., personal information), adding quizzes, more questions in each quiz, and more levels of difficulty, and introducing multimedia content (e.g., images). One user said it would be helpful to add more explanations for the words before giving the quizzes. Another user requested that the app add more interaction functions on the top of a leaderboard so users could play the learning games with their Facebook friends.

Technical elements. A few users reported that the app would sometimes force quit (i.e., shut down on its own) while they were using it. Another technical issue is that some words were misspelled. One of the users who experienced this commented, "on replaying even if we give the correct answer, [the] app showed [that the response is] wrong. The correct answer is noted by the player in first game and [when] inputted the same upon replaying, [it] turns out to be wrong. [The] options are not even visible. Try this ... FAQ ... frequently asked questions, is not even fully visible."

In conclusion, the majority of users who submitted reviews commented that the quizzes in *Johnny Grammar Word Challenge* are helpful and effective to improve their English vocabulary. However, the design of quizzes lacks pedagogical appropriateness due to the time restraint and a missing independent lesson element. The off-line function allowed learners to study without the limit of time and place. Some learners used the app for exam preparation. Users had different opinions on the difficulty level of the app and the suitable age group for users. I assume this is because the users who left comments have different levels of English proficiency. Other app features the users commented on were the distracting ads and some technical problems. They requested more multimedia elements, interactive functions, and quizzes.

5.2.2.4 Summary.

In this sub-section I presented an in-depth analysis of the *Johnny Grammar Word Challeng*e app, covering the app description, the app content as I experienced it, and user

reviews that are publicly available at the iTunes and Google Play app stores. At the end of this summary I provide some comparisons between *Johnny Grammar Word Challenge* and *Duolingo.*

Johnny Grammar Word Challenge app description. The app developer provided the users with the following information in the app description: app activities, main app features, user population, and app version history. The description of app activities and features are mostly consistent with the app content I experienced. However, the app developer claims that the app provides feedback for the wrong answer so learners know why they are wrong is inaccurate as the feedback in the app content does not show a detailed explanation for the wrong answers. Compared with the user population in *Duolingo*, the number of users for *Johnny Grammar Word Challenge* is significantly fewer—only 13,000 users. There were only 15 updates since the release of the app in May 2011; the app is updated infrequently. The main purposes of updates are to fix bugs, improve the app performance, and optimize the app to support the latest device version. The app does not have in-app purchases.

Johnny Grammar Word challenge app content. I presented a detailed description of my experience exploring the app content. Overall, the app content revealed the following quality, productive, and well-designed features:

a) Curriculum: 10 learning topics, 60-second quizzes, and no errors in the quizzes.
b) Pedagogy: Quizzes have multiple choice questions; three levels of difficulty, there is a leaderboard, and learners have free access to all quizzes based on individual needs. The app makes purposeful uses of everyday words and authentic expressions.
c) Design: The app is free to use, has an in-app link to send developer feedback and requests, saves settings, and provides off-line access to all quizzes.

Some limitations of the app features are obvious. Regarding curriculum, no learning objectives are articulated and the levels of difficulty are not clearly defined. With respect to pedagogy, the app uses only one form of learning activity—quizzes with multiple choice questions. The interaction is limited to seeing the ranks of the top 100 users and there is no opportunity for collaboration among learners. The app does not give extended explanations for the feedback, especially for the wrong answers. Regarding design, the app uses only text used in the quizzes. There are no pictures, audio or video. Although ads show up less frequently than in *Duolingo*, ads are sometimes distracting and the app is not frequently updated. Although users' settings are saved, the app does not save users' learning progress. *Johnny Grammar Word Challenge user reviews.* 84% of users shared that the 60-second quizzes enhanced their English proficiency and were helpful in recalling their prior knowledge. Some users noted that the app is easy to navigate even without instructions. According to several users' comments, the levels of difficulty are suitable for learners with all degrees of English proficiency. They stated that the app increased their confidence and encouraged autonomous learning because they were able to use to app without the limit of time and space. Users commented that the app was helpful for exam preparation (e.g., IELTS).

In contrast with these positive comments, the users also pointed out some app restraints. Regarding pedagogy, the app does not have an independent lesson explanation section. Some users found it challenging to do the practice activities without knowing a priori the vocabulary to be used in the activities. The lack of detailed feedback prevents learners from learning from their mistakes. Users also commented that there was a limited number of questions, which resulted in many repeated questions during the practice. On design, most users stated that 60 seconds is insufficient time and suggested making the timer adjustable. Some users reported technical errors such as misspelled words, the app failing to recognize

the correct answer, and regular force quits. Users suggested adding more quizzes, incorporating images and sound effects, providing a platform for users to interact with others, and allowing users to add more details to their profiles. A small number of users were dissatisfied with ads.

Comparing app features between *Johnny Grammar Word Challenge* and *Duolingo*. Both apps presented learning activities through gamification with a reward system. Overall, the two apps have similar features but some details are different (e.g., the number of lessons, levels of difficulty). The most distinct differences I observed are that *Duolingo* explains new words in the lesson while Johnny Grammar Word Challenge does not. On the other hand, Johnny Grammar Word Challenge is a free app while *Duolingo* has in-app purchase options.

To sum up, *Johnny Grammar Word Challenge* is an ESL vocabulary learning app that provides learners with 60-second vocabulary learning quizzes. The majority of its users (84%) commented that this app is effective in improving their English proficiency and that it contains some quality, productive, and well-designed features. Its limitations are the short time for each quiz and the small number of quiz questions. Users suggested adding pictures and sounds, as well as solving technical problems.

Table 5

Johnny Grammar Word Challenge Summary Table

Category	**Quality, Well-designed, and Productive features**	**Features that need improvement**
Curriculum • Learning content are provided or not • Topics • Objectives • Accuracy • Content activities	• Learning content are provided • 10 topics for vocabulary learning • No mistakes were found in the content • Quizzes • Teaches daily-used words, sentences, and authentic expressions • Suitable for learners with a certain amount of vocabulary	• No objectives • Limited number of questions and quizzes • Questions are repetitive when accessing the app more than once
Pedagogy • Learning activities • Levels of difficulty • Assessment and feedback • Gamification • Personalized learning • Autonomous learning • Social aspects • Interactions • Contexts	• Multiple choice questions for practice • Three levels of difficulty: Easy, Medium, Hard • Suitable for learners of different ages • A game style (gamification): timed 60-second quizzes • Badges as the rewards • Gain points when answers are correct, and lose points when answers are wrong • Recall prior knowledge • No time or space restraint to use the app • Feedback given after each quiz • Works well as an exam preparation tool • Leaderboard: see the rank of the top 100 learners • Uses British English; some expressions are used in American English as well	• Only one type of learning activity • Limited questions (about 20 questions) in each quiz • Levels of difficulty not clearly defined • No independent vocabulary explanations • No synonyms and detailed explanation in the feedback • 60 seconds is short and is a limitation • The length of the time and pace of the timer is not adjustable • Does not save learning progress No opportunities for users to closely collaborate with others • Only shows the ranks among top 100 learners
• App Design • Multimedia • Online/offline • Interface languages • In-device support • Technical errors • Ads	• Animation and texts • 60-second count down timer • All quizzes are accessible off-line • Three interface languages • User interface easy to use • Users can mail designers with questions and to report errors	• Animation is only used as instructions • No images, audios or other media in the quizzes Request to add profile details • App force quits sometimes

Category	Quality, Well-designed, and Productive features	Features that need improvement
	through the link “Feedback & Support” • Save users’ chosen settings • Do not need to unlock lessons and all lessons freely accessible	• App does not always recognize the correct answer • Ads pop up when accessing the app and sometimes after finishing a lesson
• General App Description • Style • Version and updates • Ratings and number of users • Stand-alone or in a suite of apps	• Login is not mandatory • A game-style design with rewards and punishments • More than 13,000 users worldwide • 4+ out of 5 rating in the iTunes and 4.4 of 5 rating in Google play • 175 ratings plus 15 reviews in iTunes, 22936 ratings in Google Play (number of reviews not stated) • 84% user satisfaction • First released May 2011 • Latest version at date of data analysis was March 2018 • App in a suite of apps for knowledge content • Total number of users not stated	

5.2.3 AnkiApp.

5.2.3.1 General description in the iTunes app store.

App activities. AnkiApp is a free flashcard app that learners use to learn English vocabulary and other subjects that require learners to memorize large amounts of knowledge. Users download flashcards or create their own flashcards. They can also synchronize cards from different devices (e.g., smartphones, tablets, and laptops). The app developers highlight these features of the app:

a) *AnkiApp* uses an improved form of Spaced Repetition (SRS) and is built with artificial intelligence (AI), which can choose flashcards for the learner to work on based on their learning progress

b) The text-to-speech function reads parts of the cards in English or other language

c) Learners can also study off-line and they can study at any time

User population. The app description does not include this information.

Reviews from app developers. The app developer claims that *AnkiApp* ranked No. 1 in the category of education apps in multiple countries and that *Techtimes* ranked *AnkiApp* as one of the best apps to learn a foreign language.

Versions and updates. AnkiApp was developed and released to the iTunes app store in October 2013 and it has had 25 updates altogether. The last version is 2.6.0, released in April 2016. When I accessed the app four months after my data collection, the app had been updated again.

Cost and paid functionality. This app does not have this feature.

5.2.3.2 Analysis of app content.

In this sub-section I provide a detailed description of my experience exploring *AnkiApp*.

Overview of the app options. In *AnkiApp*, five icons are available in the main page (also called *Dashboard* in the app) for the user to navigate the app. The first four icons are *Dashboard*, *My Decks, New Card,* and *Get Decks.* The fifth icon contains support features, which are *Profile, Settings, News, Help,* and *Contact.* The *Dashboard* summarizes the user's overall learning progress (see Figure 26). *My Decks* shows the user's vocabulary card decks in three locations: *Local, Cloud,* and *Shared*. The cards that users download from *Get Decks* or create by themselves are stored in *Cloud*. Users need to download these cards to *Local* when they want to review the cards. *Shared* contains stored card decks that are shared by other users. *Get Decks* provides learners with free downloadable English vocabulary flashcards. Not all downloadable card decks meet the user's learning needs because these cards seem to have been uploaded by other users. Some flashcards use languages that the user may not understand. In the support area, *Profile* shows the user's basic information such as user's account and app ID. *Settings* allows users to select interface language, color scheme, review details (e.g., cards number per session, font size), and whether to have auto-play video. *Help* (see Figure 26) provides frequently asked questions and answers, and *Contact* allows users to send the app developer messages to report issues about the app. I was not able to access *News* because the app forcibly quit every time I clicked this function.

AnkiApp offers four interface languages (English, Chinese simplified and Chinese traditional, Romanian, French), but the app states that users can also use their native language to create their own English vocabulary flashcards. I tried this function and successfully created English vocabulary flashcards using Chinese to explain the meaning of the word (see Figure 26).

AnkiApp requires users to have an account in order to access the app. The app does not save users' login information or downloaded card decks automatically, so users need to sign in and re-download the card decks every time they access the app. However, when I

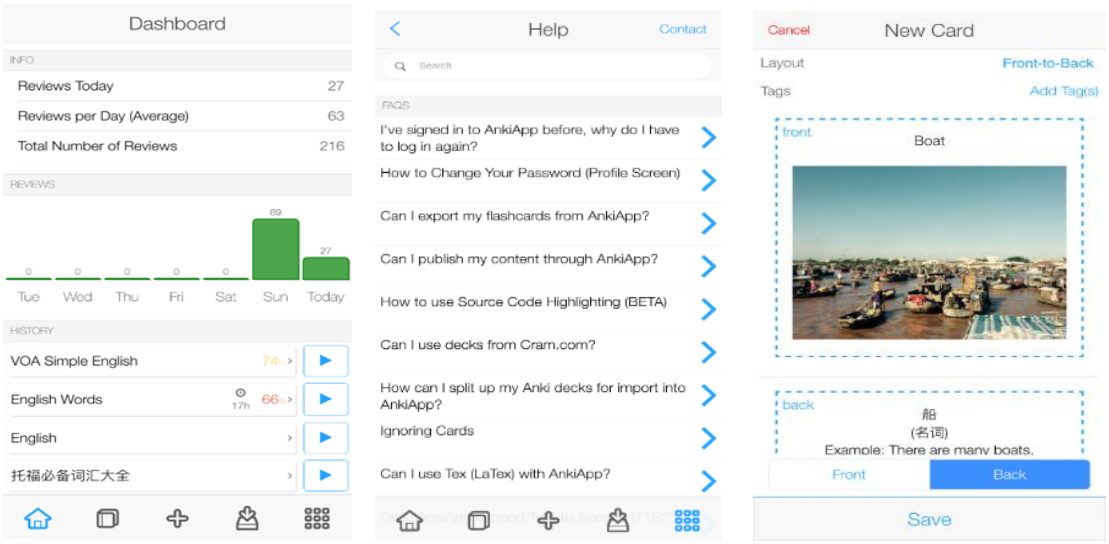

Figure 26. Dashboard, Help and New Card in AnkiApp. From left to right: *Dashboard, Help*, and *New Card* functions in AnkiApp.

accessed the app five months after the data collection, I found the app had updates. I was not signed out automatically and all the cards I had downloaded were saved in *Local*.

Learning topics, units, and lessons. This app has some English vocabulary flashcard decks available for users to download, but these decks do not appear to have been systematically designed as topics, units, or lessons. However, learners can design their own cards decks to include their preferred learning topics, units, and lessons. The titles of card deck could be designed as the learning topic, each card deck could be a lesson, and a few card decks could make up a unit.

Vocabulary learning activities—new words. Users learn new words by flipping the cards to learn the word meaning. Learners have unlimited access to all the flashcards. Some cards use different languages as the words translation in the cards (e.g., English/Korean, English/Russian, English/Japanese, etc.) that the user may not understand.

Vocabulary learning activities—practice. The main practice activity the app provides is translation. Usually each flashcard is a single word. The app also has the potential for the users to design learning activities. For example, users can design multiple choice questions

and fill-in-the-blank questions. During the practice, the user can make personalized choices to categorize their cards (e.g., star, review, tag).

Content accuracy. I did not find any mistakes in the app content.

Feedback on learning—textual correction and/or explanations. The feedback on learning in *AnkiApp* is the flipped side of the card, which contains the word translation, and sometimes an example. When users design their own cards, they can also add detailed explanations as opposed to only textual corrections.

Feedback on learning—card deck summary page. When entering each card deck, users access a page that summarizes their learning progress, including their grades in this card deck (see Figure 27). The app labels the learner's grades using both a percentage and a six-level scale (A to F) based on the user's choice of difficulty level for each card.

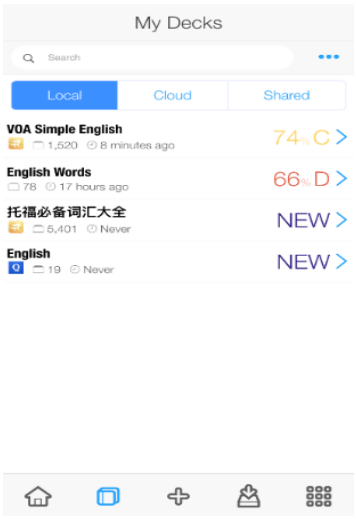

Figure 27. The card deck summary page in AnkiApp

Figure 28. Review of the card deck in AnkiApp

Levels of difficulty. This app allows users to assign a level of difficulty to each card. Users are provided with a self- grade button before they flip the card to see the answer (see Figure 28). The self-grading button includes four levels of difficulty of the words (i.e., Fail, Hard, Good, Easy). The words that the learner did not label as Easy will show up again until the learner remembers these words and chooses *Easy* as their self-directed feedback. This

allows the app to analyze the user's learning progress and decide the frequency with which a card should show up during the study process.

Social aspects. Users can share their vocabulary card decks with their friends through email. Figure 29 shows an email I sent to myself. The shared cards will show up in the other user's *Shared* location under *My Decks*.

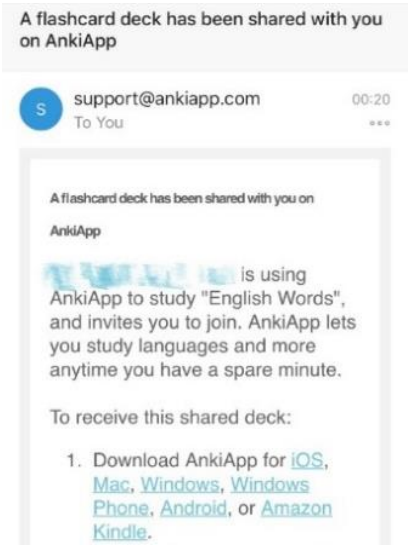

Figure 29. A flashcard sharing email from *AnkiApp*.

Gamification. This are no gamification elements in this app.

Multimedia integration. *AnkiApp* uses charts and lists to show learners' personal learning progress. The app also uses images, sounds, symbols, and texts to design the flashcards. According to my experience, these multimedia forms are incorporated successfully in the flashcards, with the exception of sounds because the sounds cannot be controlled to match the learner's learning pace. I used several multimedia forms to create new flashcards but I was unsuccessful in inserting sounds.

Off-line function. The off-line function in *AnkiApp* appears to be very limited. Not only does the app require login through an Internet connection, but it also saves the downloaded decks in *Cloud* as opposed to on the device. Users need to download cards every time they access the app in order to save the cards in *Local*. To synchronize cards on several user devices requires an Internet or other local communication connection.

Pop-up elements. This app did not have this feature. There are no ads in the app.

App support. A *Help* center is available in the *AnkiApp* app. It provides answers to frequently asked questions to support learners in navigating the app. The app designers invite users to contact them by email when they need to report problems or request support such as adding a new interface language.

In conclusion, *AnkiApp* is a free flashcard app that offers vocabulary learning. This app has some features similar to *Duolingo* and *Johnny Grammar Word Challenge*, including multimedia integration and off-line functions. Compared with *Duolingo* and *Johnny Grammar Word Challenge*, *AnkiApp* has several unique features. First, the app does not provide learners with learning topics, lessons, or quizzes. However, *AnkiApp* allows learners to create their own vocabulary flashcards with their chosen topics, lessons, and preferred activities to practice. Second, learners can create flashcards with detailed explanations on the flip side. Third, *AnkiApp* is the only app in this study that articulates levels of difficulty. Fourth, this app does not contain ads.

5.2.3.3 User reviews.

In this sub-section I present the user reviews of *AnkiApp*. I begin with general information, including the app ratings, number of the reviewed comments, and the sources of the user reviews. The majority of users focused their comments on app support and technical elements. Users also commented on app features including enhancing vocabulary, exam preparation, *and* pedagogical appropriateness, but they did not comment on feedback on learning, levels of difficulty, social aspects, gamification appropriateness, autonomous learning, personalized learning, or multimedia integration.

There were 29 ratings and 22 users review in iTunes app store for the *AnkiApp* app by March 5, 2018. Whereas *AnkiApp* was rated a four plus (4+ out of 5) star app in the iTunes app store, it was rated 3.6/5 in the Google Play store. This rating came from 350 ratings with

49 written reviews. The findings I present in this sub-section come from user reviews in both the iTunes and Google Play app stores, with a total number of 71 reviews.

Overview of the app's effectiveness. About 60% (42/71) users indicated they had had a positive experience with *AnkiApp*. They considered this free app easy to use, especially when the app allowed them to synchronize the phone *AnkiApp* app with iPad *AnkiApp* app or other devices to edit cards. Users observed that the app was easy to navigate once they got used to it. The app gave users flexibility. One user commented that "it's simple, works anywhere, and keeps things fresh so I can pull cards into daily life and 'keep going' in between lessons & study time."

Enhancing vocabulary. Users commented that this free app is a great tool to learn vocabulary. One example is: "[*AnkiApp* is] amazing! Thank you so much for this application. I have always been learning the words with a paper flashcard [*sic*], but now I am going with *AnkiApp*. So happy to find you. Will share this app with my friends on Instagram. Thank you, keep working. I love this app so much. You do create a value, you are super! Good luck!!!" *Exam preparation.* Similar to *Johnny Grammar Word Challenge*, *AnkiApp* users considered *AnkiApp* to be an effective tool for preparing for exams and tests. For example, one user commented, "This app is amazing and helps me to get the best in my exams."

Pedagogical appropriateness. The app seemed to have a limit for the number of cards users can create. One user wrote that "it does not work properly for more than 1000 words." *Off-line function.* Some users complained about the limited off-line function of the iPhone *AnkiApp*. Learners could not use the app without an Internet connection.

App support. Users claimed that the app lacked maintenance and support service when they needed it (e.g., "they do not respond to emails"). In other reviews users expressed their disappointment about the app: "it's great when it works, which is never. There is no support for it, they're basically not maintaining it at all. Even for free it's a rip-off because it

wastes so much of your time," and "this app is actually a poorly supported rip off." Some users suggested that the app needed to update the following aspects to meet individual needs: more options for card fonts and colors, notifications to remind users to study every day, capacity to insert files (e.g., audio) in cards, and the option to change deck names.

Technical elements. Over 60% of users reported that they have encountered different problems (e.g., bugs, missing cards, app operation crash, lack of support) when using *AnkiApp*. The biggest complaints users had about the app's design had to do with technical problems in creating, saving, and downloading cards. Specifically, users reported the following problems. First, the app sometimes stopped working when users tried to save cards. One user said the app shows "internal error. Contact support for help" when the user tried to save a word, while another user wrote that "my card decks come out with blank cards or missing essential text." Second, they said there were "too many glitches" (e.g., difficult to download large decks, failure to connect to server, forced quit, wrong fonts), which made the app "unreliable." Other users said the app would "randomly delete all your decks and block you from restoring them from the closed cloud system. And that can mean a dreadful loss of work! No response from support desk, nor even updates on their frequent system crashes via Twitter." Third, some users said the app crashed when they created cards, especially when they made cards with photos. A few users also mentioned loading problems (e.g., not loading, slow loading) on their mobile devices. Fourth, the app required users to log in when they re-entered the app, and *AnkiApp* also "constantly" signs the users out if they stay on one page too long without clicking on any options. Fifth, a user had a hard time controlling the audio file embedded in the deck once it started to play, which made it difficult to match the learner's learning pace with the audio pace. Sixth, although one user commented that they can learn English vocabulary anytime and anywhere (e.g., study some cards between two classes at school), over 20% users reported that *AnkiApp* should be more accessible. For

example, the app did not save the flashcards to *Local* once users logged out. Every time they logged in they had to re-download the cards from the *Cloud*. Users commented that sometimes this caused loss of the cards they had created. Seventh, the app did not always synchronize the cards from one user's device to another device effectively. One user remarked that "[*AnkiApp*] need[s] to sync more! I have 70 flashcards on the computer that I need on my phone ASAP!" and "[The cards] didn't open on my ASUS tab. Installed twice and [the] app crashes immediately on opening but it works correctly on my iOS device."

In conclusion, more than half of the users indicated that they had had a good learning experience with *AnkiApp*. The flashcards helped some users improve their English vocabulary, and this app prepared users for their exams. The majority of the user reviews were about technical issues they encountered when using *AnkiApp*, such as losing cards they created and force quit, which wasted their time and demolished the learning purpose.

5.2.3.4 Summary.

In this sub-section I presented an in-depth analysis of the *AnkiApp* app features, covering the app description on the iTunes app store, app content as I experienced it, and user reviews publicly available in both the iTunes and Google Play app stores.

AnkiApp app description. The app description in the app store presented general information from the developer's perspective. The description for *AnkiApp* includes the main learning activity, the main app features, third party reviews (e.g., *TechTimes*), and the app version history. *AnkiApp* has had 25 updates altogether since its release to the market in October 2013. The main purposes for updating were to fix bugs, improve app performance, and add access to the upgraded iOS system. The app developer stated that the users can study offline and study at any time, but according to my experience exploring the app content and the comments from user reviews, the app has very limited off-line function; in order to study off-line, the user has to connect to the Internet and download the flashcards.

AnkiApp app content. I provided a detailed description of my experience exploring the app. *AnkiApp* is a flashcard app for learning vocabulary. This app allows the users to create their own flashcards and therefore it has the potential to allow learners to design their own learning activities. Learners can learn vocabulary either by downloading flashcards from the app or by creating their own cards. Overall, the app content revealed the following quality, productive, and well-designed features:

a) Curriculum: the app content is accurate.

b) Pedagogy: Users can download and create flashcards, share decks with friends and other users via email, use the self-grading function in card review mode, and make personalized choices for card categorization (e.g., star, review, tag)

c) Design: The app makes purposeful use of images, symbols, charts, and texts. The app is free of ads, includes a *Help* page with frequent asked questions and answers, allows users to choose their preferred language to make their flashcards, and shows personal learning progress.

Some features in *AnkiApp* need improvement. Regarding curriculum, the app does not provide instructions for teachers and learners on how to develop learning activities (e.g., learning activities other than flashcards, levels of difficulty). On pedagogy, users can only share cards with other learners, but they cannot closely collaborate with each other, for example, to quiz each other through the app. From a design perspective, users cannot adjust the embedded recordings to match their learning pace. They cannot insert audio or video into new cards. Users can only use the off-line function after logging in to the app and downloading the decks to *Local* through an Internet connection.

AnkiApp user reviews. About 60% of users indicated they had had a positive experience using the app. They commented that *AnkiApp* is easy to navigate and convenient to use (e.g., synchronizing cards on different devices). Some users stated that the flashcards

enhanced their vocabulary. Similar to *Johnny Grammar Word Challenge*, users considered *AnkiApp* to be an effective tool to prepare for exams.

Some users pointed out some app limitations, including inability to control the audio files embedded in the cards, limited off-line function, infrequent updates, lack of maintenance of the app, technical problems, and difficulty synchronizing.

To conclude, *AnkiApp* is a flashcard app helps learners memorize English vocabulary. The app allows the users to create their own vocabulary cards, but it does not provide users with instructions about how to develop learning activities. According to the user reviews, *Ankiapp* has some quality, productive, and well-designed app features, but more updates are needed, especially in fixing the technical problems. Table 6 summarizes the app features of *AnkiApp*.

Table 6

AnkiApp Summary Table

Category	**Quality, Well-designed, and Productive features**	**Features that need improvement**
• Curriculum • Learning content are provided or not • Topics • Objectives • Accuracy • Content activities	• Learning content are not provided • Vocabulary learning • Did not find mistakes in content • Access to few app-created cards. • Tailored to individual vocabulary learning needs	• No pre-existing units, lessons, topics, skills • No summary key words to be learned
• Pedagogy • Learning activities • Levels of difficulty • Assessment and feedback • Gamification • Personalized learning • Autonomous learning • Social aspects • Interactions • Contexts	• Vocabulary flashcards for practice • Tailored to individual needs through making own cards and tagging cards • Four different difficulty levels for the self-grading function • Users can tag cards to identify difficult levels • AI and responsiveness to present cards tagged as more difficult • Responsive in returning to cards that the user tags as more difficult • Progress reports in form of charts and lists • No timed activities • Personalization options • Cards may contain translations, sentences and meaning of a sentence • Works well for use as exam preparation • Email decks to other users • Shared deck tab	• Users request user notifications and reminders on learning progress • No levels of difficulty • No units, lessons, or quizzes • Activities limited to flashcards and no choice for other learning activities such as links to meanings of words, matching, multiple choice, dictation, and reading learning activities • No progressive lessons • No instructions for teachers and learners • No choice of learning level • No interaction opportunities beyond friends such as in the form of joining global challenges or viewing past challenges
App Design • Multimedia • Online/offline • Interface languages • In-device Support	• Photos, text, charts, lists, audio files • Auto-play audio option • Choice of font and color of the cards • Accessible with Internet • Use on different mobile as well as computer devices	• No audio controls on playback • Sound or video cannot be inserted into cards • Signed out when device is dormant • No data saved on local device • Constant need to sign in • At times saved cards are lost

Category	Quality, Well-designed, and Productive features	Features that need improvement
• Technical errors • Ads	• Choice of target language • Five interface languages • All work is saved in the cloud • FAQ/help sections • Users can email designers with questions and to report errors • No ads • No in-app purchase	• Timing out • Embedded recordings do not match the learning pace • Technical glitches on own cards, and synchronization on devices • Infrequent updates • Add more functions in font, color, voice in card design and notification • Lack of maintenance support • Limited app support • User complained that emails not responded to
General App Description • Style • Version and updates • Ratings and number of users • Stand-alone or in a suite of apps	• Login and creating a profile is mandatory • No gamification elements • Flashcard practice • 4+ out 5 rating in the iTunes and 3.67 out of 5 rating in Google play • 29 ratings plus 22 review in iTunes and 350 ratings plus 49 reviews in Google Play • 60% user satisfaction • First released October 2013 • Latest version at date of data analysis was April 2016 • Part of a suite of apps for knowledge content • Total number of users not stated	

5.2.4 Conclusion.

In this section I provided a detailed descriptive analysis of the features of the three selected vocabulary apps: *Duolingo*, *Johnny Grammar Word Challenge*, and *AnkiApp*. Features I examined were mainly in three categories: curriculum, pedagogy, and design. Some features are quality, productive and well-designed, whereas other features need improvement. Findings from the app description, app content, and user reviews show similarities and differences among three apps.

The common features in the three apps are vocabulary learning activities, content accuracy, feedback on learning, levels of difficulty, social aspects, multimedia integration, off-line function, and app support. The biggest difference is that *Duolingo* and *Johnny Grammar Word Challenge* provide users with learning content through game-style learning activities, and these two apps contain ads; *AnkiApp* allows users to develop their own learning content using flashcards, and this app do not have ads. However, *AnkiApp* allows learners to create their own vocabulary cards and has the potential for learners to develop their own vocabulary practice activities. Other differences are that both *Johnny Grammar Word Challenge* and *AnkiApp* are free, and, according to the users, both apps useful for exam preparation. *Duolingo* is a freemium app. In the next section I present the modified app evaluation checklist. Table 7 illustrates the detailed similarities and differences among *Duolingo*, Johnny Grammar Word Challenge, and *AnkiApp*.

Table 7

A Comparison of App Features Among Duolingo, Johnny Grammar Word Challenge, and AnkiApp.[15]

Features		**Duolingo**	**Johnny Grammar Word Challenge**	**AnkiApp**
Learning objectives		key words in each lesson	**no key words**	**no key words**
Learning topics		55 topics with over 150 lessons; each topic has up to 8 lessons	10 topics with 30 lessons; each topic has one lesson	no topics
Learning activities	*new words*	new words marked with dotted lines and explained in practice	new words not explained	new words translated at the back of the card
	practice activities	lessons and **quizzes** in the forms of **multiple choice questions**, translation, word-sentence dictation, and word match	**quizzes with multiple choice questions**	flashcards
Content accuracy		one grammar mistake	**no mistakes**	**no mistakes**
Placement test		Yes	**No**	**No**
Feedback		immediate feedback after each question, **no detailed explanation**	immediate feedback after each quiz, **no detailed explanation**	immediate feedback on the flipped side of the card, may have explanation
Levels of difficulty		one level	three levels (hard, medium, easy)	four levels (Fail, Hard, Good, Easy)
Social aspects	*social interaction*	**leaderboard** (add friends to show on the board), language club	**leaderboard** (top100 learners automatically show on the board)	Sharing cards through emails

[15] **Bold text** indicates similarities among the three apps.

Features		**Duolingo**	**Johnny Grammar Word Challenge**	**AnkiApp**
	learning collaboration	**learners cannot collaborate in learning activities**	**learners cannot collaborate in learning activities**	**learners cannot collaborate in learning activities**
	social context	**Not identified**	many everyday life expressions, especially used in British English	**Not identified**
Classroom features		Yes	**No**	**No**
Gamification	*rewards*	**badges,** gems, XP, health bar	**badges**	No
	time constraints	five mistake limit	60-second limit	No limit identified
Multimedia integration		**animation, text**, **images, sounds**	**animation, text**	Charts, lists, **images, sounds,** symbols, **text**
Off-line function		lessons are off-line, but quizzes are not in free app version	**all lessons are accessible off-line**	**all lessons are accessible off-line**
Pop-up element		**has ads** after every lesson	**has ads** when assessing the app and sometimes after a lesson	No ads
App support	*updates*	about once every week	about three times per year on average	about four times per year on average up to 2016
	sending feedback	**link to send app developers feedback**	**link to send app developers feedback**	**link to send app developers feedback**
App transaction		in-app purchases	**free**	**free**
Other		**saves user's profile, rewards, and settings**	**saves user's profile, rewards, and settings**	**saves user's profile and settings**
		saves learning progress	does not save learning progress	does not save learning progress

5.3 Modified App Evaluation Checklist

In Chapter 2 I developed a preliminary app evaluation checklist that has the potential to be used to assess ESL app quality. In this section I report on how I modified this checklist based on my in-depth analysis of the *Duolingo*, *Johnny Grammar Word Challenge*, and *AnkiApp* apps. From the in-depth content analysis, some common features (e.g., learning topics and app support) and examples (e.g., translation, quiz, etc.) emerged that were not covered in the research I reviewed in Chapter 2. I added these features as new criteria and examples as elaborations in the app evaluation checklist. Other themes, such as incorporating multimedia elements and providing social contexts, emerged from the literature.

The revised app evaluation checklist contains three categories and 16 criteria. The main changes include modifying and adding criteria. The three main categories—Curriculum, Pedagogy, and Design—remain the same. Two criteria were added based on the findings of the in-depth analysis:

(a) "Various learning topics are included in curriculum content of the app to enrich learners' language learning experience." (criteria 5 in the *Curriculum* category)

(b) "Provides app support in response to learners' needs (e.g., regular updates based on learners' feedback; several interface languages; in-app or online support, etc.)." (criteria 5 in the *Design* category)

The emergent app features and app learning activities also contributed examples for me to modify some criteria. First, examples from the findings (e.g., translation, quiz, etc.) were added to the forth criteria in *Curriculum*. Second, I added "detailed" to the first criteria in *Pedagogy* according to the users' request to have detailed explanations in feedback. Third, I added "collaboration" to the third criteria in *Pedagogy* because the findings showed that users preferred to collaborate with other users in learning. Fourth, I added examples (e.g., free access anytime, save learning progress, etc.) to the sixth criteria in *Pedagogy*. Fifth, I

added “that allows the learners to access the learning content anywhere and anytime they want” according to users’ comments in criteria two in *Design*. Sixth, I changed the third criteria in *Design* “no pop-up elements during the use of the app” to “(pop-up elements) do not distract learners during the learning process” to emphasize not to distract learners’ learning process as opposed to not having ads.

Another change is that I changed the Likert Scale in the preliminary app evaluation checklist to a yes/no scale. This is because I found it difficult to unify the grading standard, especially when some criteria are simply yes/no questions. An example of this type of questions is “the app has off-line functions.” The role of the “notes” in the app evaluation checklist was added to provide the users a space to record their own observations as they evaluate an app. In Table 8 I present the *Modified App Evaluation Checklist*.

Table 8

Modified App Evaluation Checklist [16]

Categories	**Criteria**	**Yes/No**	**Notes**
Curriculum	1. Articulates learning objectives that are achievable through the app's content		
	2. Provides rich, appropriate learning content through different learning activities (e.g., level challenges, and games, etc.).		
	3. Has accurate learning content.		
	4. Provides *various* content activities *(e.g., translation, quiz, etc.)* that can improve learners' learning.		
	5. *Various learning topics are included in curriculum content of the app to enrich learners' language learning experience.*		
Pedagogy	1. Gives *detailed* feedback to learners.		
	2. Articulates the levels of difficulty of the learning content.		
	3. Allows social interaction and *collaboration* among learners.		
	4. Integrates social context.		
	5. Provides personalized options that can satisfy users' individual needs.		
	6. Facilitates autonomous learning *(e.g., free access anytime, save learning progress, etc.).*		
Design	1. Contains different forms of multimedia (e.g., video, audio, and image, etc.) that are purposefully incorporated in the learning content and activities.		
	2. Has off-line functions *that allow the learners to access the learning content anywhere and anytime they want.*		
	3. *(Pop-up elements) do not distract learners during the learning process.*		
	4. No technical elements that influence learner's overall learning experience.		
	5. Provides app support according to learners' needs (e.g., regular updates based on learners' feedback; several interface languages; in-app or online support, etc.).		

[16] Italicized words, phrases, and sentences denote added or modified criteria.

5.4 Summary

In this chapter I presented my research findings on the three research questions. I first presented results on the 20 ESL learning apps and 10 utility apps that are most commonly recommended in the iTunes and Google Play app stores. The learning apps were for mobile devices (except for one app in the reading category), had off-line functions, were free, freemium, or had over 60% free content. I then presented a detailed descriptive content analysis of three sampled vocabulary apps: *Duolingo*, *Johnny Grammar Word Challenge*, and *AnkiApp*. I analyzed each app, exploring three recording units: the app description in iTunes app store, the app content as I experienced it, and user reviews from the iTunes and/or Google Play app stores. Findings from the in-depth analysis show several common features among the three apps, including personalized options, multimedia integration, and social interaction. The findings also show that some app features are quality, productive, and well-designed while others are not. In the last part of this chapter, I presented the *Modified App Evaluation Checklist*. The revisions included several new criteria and descriptors as well as the modification of some categories and descriptors that were in the *Preliminary App Evaluation Checklist*. In the final chapter I discuss my findings, present the limitations of this research, and suggest direction for future studies.

Chapter 6

6 Discussion

Learning apps are becoming ubiquitous in and out of the classroom, and they have had exponential growth since their introduction (Mindog, 2016). However, it is a great challenge to determine the best apps to use in and outside of the classroom (Kim, Rueckert, Kim, & Seo, 2013). In this study, I explored the most commonly recommended affordable ESL learning apps available in both the iTunes and Google Play app stores. I investigated the features of the most commonly recommended affordable ESL vocabulary learning apps and developed an app evaluation tool to assess the quality of ESL learning apps. I used inductive and deductive approaches in my in-depth qualitative content data analysis. In the analysis I studied three recording units: app description, my own experience exploring the app content, and user reviews of the selected ESL vocabulary learning apps (i.e., *Duolingo*, *Johnny Grammar Word Challenge*, and *AnkiApp*). This chapter discusses findings of the study that are related to the research questions.

6.1 The Most Commonly Recommended Apps

My findings on the most commonly recommended apps in both the iTunes and Google Play app stores show that these apps fit under several categories. I also contribute more and current examples. It appears to be common that not only are apps designed for learning different languages in addition to English, but many apps, such as *Duolingo* and *Johnny Grammar Word Challenge*, are designed to teach more than one English language skill. In the literature review chapter, I showed that the ESL app market is dominated by apps that enhance listening skills (e.g., *Lingo Arcade*, *Clear Speech App*, and *Listening Drills*) and vocabulary skills (e.g., *English LaunchPad*, *Idioms*, *Guess it! Language Trainer*). There are very few apps for other English language skills such as pronunciation, grammar, speaking, and writing. By contrast, my findings on the most recommended ESL apps (see Table 2) from both the iTunes and Google Play app stores show that several apps enhance not only learners'

vocabulary and listening, but also their grammar, pronunciation, reading, and speaking. Although I found three apps for reading skills, one is only for ECE learners and another does not meet the app inclusion criteria because it costs more than $10 CAD. I found one app that contains features that enhance learners' spelling, whereas previous research did not recommend any spelling apps. In line with what I found in the literature, I found no writing app for this study.

These findings reveal that the ESL reading apps and writing apps are not emphasized by researchers when studying ESL learning apps or by the app developers who design ESL learning apps. Although I looked at studies from the ten most recent years, many of the apps recommended in the reviewed studies are already inaccessible in the app stores. Further, for this study I found only a few of the apps mentioned in the reviewed literature (e.g., *Duolingo*, *Google Translate*) to be among the most commonly recommended apps. This finding indicates that ESL apps are not only growing exponentially in number, but they are also getting updated quickly and some no longer exist in app stores.

6.2 App Features

The findings from my in-depth content analysis of the vocabulary learning apps show two of the three learning apps—*Duolingo* and *Johnny Grammar Word Challenge*—provide the learning and practice activities for learners. These two learning apps, designed with gamification, have some common features such as learning topics, lessons, and units, and quizzes, while the other—*AnkiApp*—does not. The number of user ratings and user reviews suggest that apps providing learning and practice activities for learners are usually more widely used compared with ESL learning apps that do not provide users learning activities, especially when there are no instructions for them to design their own learning activities (e.g., *AnkiApp*).

The findings suggest that, although the apps are designed with different instructional methods (e.g., quizzes, flashcards), all three apps in this study have potential to enhance learners' vocabulary. For example, one user of *Johnny Grammar Word Challenge* said, "this game is great to learn British council *[sic]* and I learn many words to gain my vocabulary and I learn some words be *[sic]* a different meaning in other contexts." This user highlighted two app features—game play and context—as enhancing vocabulary learning.

The findings reveal that some common app features are multimedia integration, off-line access, feedback on learning, personalized features, quizzes as the predominant learning activity, and in-device app support. Not all the apps contained features such as levels of difficulty, learning objectives, app transactions, and ads. Some features are exemplar features that contribute to effective ESL learning, whereas other features need improvement (e.g., adding detailed feedback on learning and providing independent vocabulary explanations). In this section, I discuss the app features in three aspects: curriculum, pedagogy, and design.

The Ontario Ministry of Education (2007) ESL curriculum for secondary school learner, as an example of ESL programmatic curriculum, highlights the importance of the following: of ESL course learning objectives that aid students to develop skills that they need; of rich learning content for learners to practice different English skills; as well as of placing learners in appropriate learning levels based on their English proficiency. In this section the first two are addressed as part of curriculum and the last on is returned to later when discussing pedagogy.

6.2.1 Curriculum.

The findings from Chapter 5 showed that a quality app often contains five curriculum elements: learning objectives, rich and appropriate learning content, content accuracy, content activities, and learning topics. Of the three vocabulary learning apps in this study, none contains all five elements.

From the perspective of learning objectives, *Duolingo* provides a list of key words on the main page of a lesson. These key words provide learners with a clear purpose which allows them to focus on the lesson. I consider these key words to be the learning objectives. *Johnny Grammar Word Challenge* and *AnkiApp* do not have this feature. The lack of clear learning objectives may confuse learners in terms of the learning focus of the lessons, the level of difficulty of the learning materials, and the proficiency learners should have before attempting the learning. For example, users of both *Duolingo* and *Johnny Grammar Word Challenge* commented on the levels of difficulty with very different perspectives. One *Duolingo* user opined, "that's a great app for beginner[s] like me to learn English," whereas another user commented it was a "superb application for intermediate knowledge of English."

Regarding rich and appropriate content, I did not find any inappropriate content in *Duolingo, Johnny Grammar Word Challenge, and AnkiApp*. I consider that *Duolingo* has rich learning content because *Duolingo* provides more than 150 lessons for the learners and each lesson intend to teach different vocabulary. It is likely learners can achieve certain levels of English proficiency with this amount of learning content. *Johnny Grammar Word Challenge* has 30 quizzes altogether and each quiz is 60 seconds. In addition, the learners claimed that the limited number of questions in each quiz resulted in occurrence of frequently repeated questions. For these reasons, I consider *Johnny Grammar Word Challenge* do not have rich learning content because learners may finish practicing all the quizzes in this app in 30 minutes. From the amount of learning content *Johnny Grammar Word Challenge* provides, it is less likely users will use this app as a regular learning app. *AnkiApp* do not have rich learning content, either. *AnkiApp* provides downloadable card decks but not all of these card decks meet the users' learning needs because some cards use different languages as the words translation in the cards (e.g., English/Korean, English/ Russian, etc.) that the user may not understand. Therefore, I do not think that *AnkiApp* has rich content.

In term of content accuracy, all three apps have accurate content, except that I found one grammar mistake in *Duolingo*. In my opinion, any mistake should be avoided because mistakes affect learning effectiveness and may lower learners' trust of the app content. According to Krashen's (1989) affective filter theory, learners' affective filter is influenced by their motivation, self-confidence, and learning interest. When the learning content contains mistakes, it is more likely that the learners have less motivation and interest in the app, which may create a high affective filter. A high affective filter affects the amount comprehensible input the learners may receive.

With regard to content activities, *Duolingo* uses lessons and quizzes in the forms of word-sentence dictation, translation, word matching, as so on to present the learning materials. *Johnny Grammar Word Challenge* and *AnkiApp*, on the other hand, use only one type of learning activity. *Johnny Grammar Word Challenge* uses quizzes with multiple choice questions, whereas *AnkiApp* utilizes flipped flashcards. The Ontario ESL curriculum (Ontario Ministry of Education, 2007) suggested to provide frequent opportunities to practice different English skills and to interact with other learners in a purposeful way. This appears that *Duolingo* is the only app in this study that has various content activities as a quality curriculum feature. Even so, there is no evidence showing that Duolingo incorporates content activities that allow learners to interact with others. According to Long's interaction theory (1996), this might be insufficient for the learners' to improve their language efficiency.

With respect to learning topics, both *Duolingo* and *Johnny Grammar Word Challenge* provide learners with a choice of vocabulary topics related to everyday life. The downloadable card decks in *AnkiApp* did not have this feature, but learners may include their own topics when creating personal flashcard decks. Learning topics help the learners navigate the learning content better, which may contribute to their autonomous learning.

In conclusion, the common curriculum features of the three vocabulary learning apps are accurate learning content, appropriate learning content, and inclusion of content activities. In addition, *Duolingo* specifies the learning objectives and offers rich learning content. *Duolingo* and *Johnny Grammar Word Challenge* have learning topics and provide learning and practice activities for the learners, whereas *AnkiApp* does not. Curriculum features such as content activities and learning content also exist in *Johnny Grammar Word Challenge* and *AnkiApp* but they are not quality curriculum features. For example, Both *Johnny Grammar Word Challenge* and *AnkiApp* have content activities, but these two apps only have one form of content activity as compared to *Duolingo* which has several content activities. *AnkiApp* contains learning content; however, the learning content is very limited. Johnson (1967) noted that curriculum, as the "planned learning experiences" (p.129), plays a role in guiding instruction. This indicates the curriculum elements – of learning objectives, rich and appropriate learning content, content accuracy, content activities, and learning topics – help learners to navigate and benefit from the learning and practice activities in the ESL learning apps.

6.2.2 Pedagogy.

In Chapter 5 I presented the following major features that may be productive in ESL learning using a mobile app: feedback on learning, levels of difficulty, social aspects, gamification elements, and personalized options (e.g., placement test).

6.2.2.1 Feedback on learning.

Feedback is considered as an important element in the ESL curriculum (Ontario Ministry of Education, 2007). Smith and Higgins (2006) stated that without effective feedback, the productivity of learning cannot be guaranteed. My study found that *Duolingo, Johnny Grammar Word Challenge*, and *AnkiApp* all provide feedback for learners. What is surprising is that although all the apps give immediate feedback, none of the apps gives

detailed explanations in the feedback. *Duolingo* also gives learners feedback through their phone screens and email, but these do not contain detailed feedback either.

Language apps are often designed for stand-alone self-study purposes rather than as classroom support resources (Sweeny & Moore, 2012). Of the three learning apps in this study, only *Duolingo* has classroom feature. When an app delivers feedback in the form of textual correction, it is insufficient to have only immediate feedback, especially when learners use the app for stand-alone self-study as opposed to as a classroom learning tool. Krashen (1989) stated that language learners acquire language in a context that is just beyond their current knowledge level. When learners use an ESL learning app without external help, it is important that the learning activities in the app are at a level that is within the learners' reach. When an app does not provide learners with detailed explanations for their mistakes and advice on how to avoid the mistakes in the future, the learning activity is likely to lower the level of comprehensible input the learner receives. This diminishes the effectiveness of the learning activities. This is also revealed in the user reviews, where one user commented, "it would be more helpful if this app has explanations for the answers. Especially [the] incorrect [answers]."

Forsythe (2013) stated that the incorporation of immediate feedback facilitates autonomous learning opportunities. However, Forsythe failed to realize the importance of detailed feedback in learners' autonomous learning. The purpose of autonomous learning is to hand over the learning responsibility to the learners to help them acquire meaningful learning through the motivational advantage of self-study (Al-Hashash, 2007). When learners only have an answer without knowing the cause, they may not be able to make connections with their prior knowledge and will thus fail to direct their own learning activities. The learners' mistakes may accumulate, which may create a high affective filter level (Krashen, 1989). For these reasons, it is not sufficient to provide only correct answers for learners. A

productive feedback feature also includes a detailed explanation that increases learners' comprehensible input, enhances autonomous learning, and maximizes their understanding of the lessons.

6.2.2.2 Levels of difficulty.

The Ontario ESL curriculum (Ontario Ministry of Education, 2007) highlighted five levels of difficulty in ESL learning based on the learners' English proficiency. The document states that by doing so, the learners would be placed at appropriate learning levels. ESL learning apps, especially these that were designed for stand-alone self-study purposes, should include different levels of learning content that may suit learners of different language proficiency.

From the in-depth analysis of the app content and user reviews, it appears that all apps do not have clear levels of difficulty. *Duolingo* has one level of difficulty but the levels of difficulty in this one level appear to become more advanced as the lessons and units progress. Each unit in *Johnny Grammar Word Challenge* has three levels of difficulty (i.e., easy, medium, and hard). Nevertheless, the app developers do not explain the level of language proficiency that relates to each of the three levels of difficulty. *AnkiApp* does not show this feature. User reviews indicate that some users of *Duolingo* and *Johnny Grammar Word Challenge* are confused about the levels of difficulty in both apps. One *Duolingo* user's comment opined, "If I didn't already know a little of the language, I think it would be very difficult." While other users commented that "*Duolingo* does a very good job, but I wish there was more in-depth learning." Providing several levels of difficulty in an app is important because it is much easier for learners to understand the knowledge and gain more comprehensible input (Krashen, 1989) when they are placed at the appropriate levels of difficulty or when they select learning content suitable for their learning needs and skills.

6.2.2.3 Social Aspects.

Second language learning often takes place in the context of interaction with others (Chik, 2014). The connectivity function of mobile apps makes the social interaction easy among learners (Niño, 2015). The communicative potential brought by connectivity is key for learning language and makes it convenient for learners to interact with themselves, others, and surrounding environments (Beach & O'Brien, 2015).

As evidenced in my findings, all three apps incorporated a certain level of social interaction. *Duolingo* and *Johnny Grammar Word Challenge* both have a leaderboard where learners compete with others to appear on the ranking list. *Duolingo* also provides a language club where users can track team progress and communicate using customized emoji and phrases. *AnkiApp* allows users to share flashcards with others through emails. These findings support the claim of Bárcena et al. (2015) that many apps have some but insufficient social interaction. The social interaction elements in these three apps are not sufficient because the learning activities do not involve collaboration. This explains Berns, Palomo-Duarte, Dodero, Ruiz-Ladrón and Calderón Márquez's (2015) claim that learning apps in the market supported mostly individual learning because these apps mainly deliver content rather than providing learners with the opportunity to interact with each other. Vogotsky's (1978) ZPD claimed that collaboration among learners assist learners to solve their learning problems. The ESL curriculum (Ontario Ministry of Education, 2007) emphasizes the importance of providing rich and frequent opportunities for learners to interact with other learners. One way the ESL curriculum suggests is to offer collaborative learning activities as an instructional approach to allow learners to work together to complete learning tasks.

It seems commonplace to have a leaderboard in a game-style learning app. This feature is perhaps for the purpose of motivating learners. However, the leaderboard does not allow users to take advantage of the collaborative potential of mobile apps to interact directly

with others. Although users can share their cards on *AnkiApp*, they are not able to collaborate with each other in the learning process. For example, they are not allowed to quiz each other using the flashcards. The interaction theory (1996) highlighted that effectiveness of comprehensible input may be significantly improved if the learner negotiates for meaning. However, the negotiation process cannot happen without opportunities for learners to collaborate with their peers. Users commented in the reviews that they hoped to be able to play the learning games with their Facebook friends. This indicates that they expect to be able to interact with users on the level of shared learning. In conclusion, the findings of the apps in this study indicate that app developers need to improve the social aspect of ESL learning apps.

Social context is another important social aspect of ESL learning apps. The ESL curriculum (Ontario Ministry of Education, 2007) noted that ESL learning activities should integrate social context instead of being practiced in isolation. Social context provides additional means for learners to enhance their vocabulary (Heil, Wu, Lee, & Schmidt, 2016). In this study, the social context feature is unique to *Johnny Grammar Word Challenge*. This is because *Jonny Grammar Word Challenge* utilizes British English expressions in the learning activities. This information may benefit users who need to prepare for an exam mainly using British English. One user commented in the user reviews that *Johnny Grammar Word Challenge* provides "amazing game to teach me more about English language especially for my dream in IELTS exam."

Some users commented that *Duolingo* should improve the social context of the learning activities because some expressions are not commonly used in everyday life. Although *Duolingo* utilized animated images to teach vocabulary, it does not appear to be the same as images from real life, and therefore, has a limited contribution to the social context of the app. Similarly, there is no social context feature in *AnkiApp* because it consists of

flashcards that are often used to learn single word. All three apps appear to need improvement in order to maximize their connectivity potential and create interactive opportunities among learners in a social context.

6.2.2.4 Gamification.

Gamification is commonly used in apps recommended in both the literature (e.g., *Clear Speech, MindSnacks*) and the vocabulary learning apps I studied in-depth. *AnkiApp* does not use gamification because it does not provide game elements like rewards or leaderboards.

The most common gamification features are rewards, leaderboards, and time constraints. *Duolingo* provides learners with several rewards—gems, experience points (XP), and badges. Besides rewards, each *Duolingo* user has a health bar that allows users to make five mistakes; once the limit is reached, users have to wait almost a whole day for more game time. *Johnny Grammar Word Challenge* has a 60-second time constraint for each quiz.

All in all, over 80% of both *Duolingo* and *Johnny Grammar Word Challenge* users reported that they liked to learn through games, which provided them with both challenges and encouragement to make the learning process fun. From this perspective, gamification increases learners' engagement and confidence, creating a lower affective filter level for ESL learning. Other users, however, stated that the waiting time for the health bar recovery in *Duolingo* was too long and they could not finish a lesson with insufficient health points. Users of *Johnny Grammar Word Challenge* commented on the insufficient time for each quiz. The upper mistake limit and time constraint may add to learners' "mental block" and increase their affective filter (Krashen, 1989). Further, the ESL curriculum (Ontario Ministry of Education, 2007) encourages to utilize instructional approaches that allow students to make mistakes and learn from their mistakes. It appears that the constraint of the upper five mistakes limit discourages this purposes. *Duolingo* and *Johnny Grammar Word Challenge*

both have a leaderboard that ranks users by their XP points. Some rewards—such as earning gems through watching ads—may distract learners. Bárcena et al. (2015) noted that game features distract users from focusing on a single activity and positioned apps as sources of entertainment rather than as learning tools. One implication of the app being considered a form of entertainment is that gamification activities should be carefully designed so as to avoid distracting learners. The gamification should be purposefully designed in order to increase learners' comprehensible input. For example, *Johnny Grammar Word Challenge* includes badges as rewards, but the app does not explain what tasks the user should complete in order to obtain these badges. It is very likely that the users are not encouraged or excited about this feature.

6.2.2.5 Personalized options.

Learners differ in their learning needs, interests, styles, motivations, strengths and weaknesses (Al-Hashash, 2007). Kukulska-Hulme and Traxler (2007) emphasized that personalized app features satisfy users' individual needs. Findings show that all three apps portrayed some personalized features. Apps may detect the frequency of different types of learner errors (Heil, Wu, Lee, & Schmidt, 2016). *Duolingo* provides a "weak words" section for learners to practice their weak words. *AnkiApp* has a self-grade function that analyzes the user's learning progress and decides the frequency with which a card should show up during the study process. When presented this information, learners may notice their mistakes that may be otherwise neglected (Heil, Wu, Lee, & Schmidt, 2016).

All three apps save users' individualized settings, but only *Duolingo* allows users to save their study progress on the device. *Duolingo* users said that the app is tailored to the user's proficiency through a placement test and that this contributed to their vocabulary improvement. It may bring the app users convenience when the app saves the user's settings (e.g., interface language, font, color, etc.). Compared with saving settings, it is more

important to save learners' study progress and provide learners appropriate levels of learning content through assessment (e.g., placement test) so they can acquire meaningful learning using the motivational advantage of self-study (Al-Hashash, 2007).

Johnny Grammar Word Challenge and *AnkiApp* allow learners to access lessons and quizzes unlimited times. *Duolingo* users can freely access the lessons they have already practiced. With the possibility to access learning materials and activities unlimited times, learners do not need to commit vast amounts information to memory and having this information stored on the device readily available at any given moment (Pachler, 2009) lessens the learners' cognitive load.

With these personalized features, learners are able to make their own decisions according to their own learning pace, which promote autonomous learning (Al-Hashash, 2007). According to Krashen's (1989) affective filter theory, learners may feel more comfortable and confident in an environment where they can personalize their learning.

6.2.2.6 Summary.

I talked about the pedagogical features of ESL learning apps in this sub-section, including feedback on learning, levels of difficulty, social aspects, gamification, and personalized options. These pedagogical features in ESL learning apps has some similarity to the instructional approach in the Ontario ESL curriculum (Ontario Ministry of Education, 2007). Some major pedagogical approaches illustrated in the Ontario ESL curriculum document are the integration of social context, allowing students to learn from mistakes, bridging learners' prior knowledge, providing corporative opportunities, using visuals and multimedia, and providing appropriate learning levels.

Some pedagogical features of the ESL learning apps are productive, such as use of the social context in *Johnny Grammar Word Challenge*, various learning games in *Duolingo*, and unlimited access to lessons and practice-activities in all three apps. However, some

pedagogical features of the apps in this study need improvement. None of the three apps in this study provide detailed feedback to the users. All three apps do not provide clear explanation for the different levels of difficulty in the learning content. Although all three apps provide a certain level of social interaction (e.g., leaderboards, sharing cards in emails), none of the apps provided collaborative opportunities for the users to interact with other students in the learning process. *Duolingo* sets an upper limit of five for learners' mistakes, which hinders learners' opportunity to learn from their mistakes. *Johnny Grammar Word Challenge* has 60-second time constraint, which is an obstacle for learners to learn at their own pace.

6.2.3 App Design.

Five features were found in the app design of the three apps in this study: multimedia integration, off-line function, pop-up elements, app support, and technical elements. Some features are common, while others are unique to some apps.

6.2.3.1. Multimedia Integration.

Findings reveal that all three apps in this study utilize multimedia in lessons and practice activities. *Duolingo* has animated images, text, and audio; *Johnny Grammar Word Challenge* integrates text and animation; and *AnkiApp* includes charts, lists, images, sounds, symbols, and texts. The multimedia feature of software downloaded on portable digital tools has the potential to motivate students and help them engage in effective English language learning (Beach & O'Brien, 2015; O'Brien & Voss, 2011). *Duolingo* and *AnkiApp* present new words through relevant animated images (*Duolingo*) or real life pictures (*AnkiApp*) to help learners understand the meaning of a word, which may as well increase the amount of comprehensible input (Krashen, 1989) the learners receive. *Duolingo* purposefully uses several media forms for different learning activities such as audio for word-sentence dictations, text for translation, and animation for instruction in different learning activities.

Users claimed that these multimedia elements increased their engagement level and learning efficiency in vocabulary and even other language skills such as listening and speaking. According to Krashen's (1989) affective filter theory, when the app users feel comfortable and confident in the learning process, they may have a low affective filter which allows unconstrained access to comprehensible input. These multimedia forms used in the apps, as Wu and Marek (2010) stated, enable the creation of a learning environment in which students are able to interpret knowledge and study without additional assistance.

Not all forms of media integration are well-designed. *Johnny Grammar Word Challenge* only has text in the quizzes. Users commented that the learning process may be more effective when incorporating graphics and other forms of media in the quizzes, especially with the limitation of 60 seconds for each quiz. Technical problems (e.g., the microphone issue in *Duolingo*, mismatches between the audio and words in *AnkiApp*, etc.) arose when I explored the apps. User reviews also pointed out the technical problems regarding multimedia. Mayer (2014) argues that multimedia elements should be purposefully added to text. When multimedia is not properly incorporated into the learning activities, chances are that the app fails to increase the comprehensible input which diminishes the purposes of having multimedia in an ESL learning app.

6.2.3.2 Off-line function.

The findings show that all three apps in this study have some off-line functions. This feature is consistent with the features of MALL which increase the flexibility of mobile learning apps in terms of where and when learning happens (Hoppe, Joiner, Milrad, & Sharples, 2003; Kim, Rueckert, Kim, & Seo, 2013; Miangah & Nezarat, 2012). All lessons in *Johnny Grammar Word Challenge* are accessible off-line. Whereas *Duolingo* provides free off-line access to lessons, only in-app purchases include quizzes for the downloaded app. The developers of *AnkiApp* claim that this app has off-line access but learners need the Internet to

access the app and download the flashcards from the cloud to their devices before using the app off-line. It appears to be very important for some users to have full app access off-line as four *Duolingo* users commented that it was inconvenient not to be able to do quizzes off-line. This observation is significant because there is a potential risk for users to have a high affective filter (Krashen, 1989) when the learning content is not available off-line.

6.2.3.3 Pop-up elements.

The findings also show that having ads is another common feature in ESL learning apps. Both *Duolingo* and *Johnny Grammar Word Challenge* have ads. Although *Duolingo* app developers explained in the pop-up ads that "this ad helps education free", many users found the ads distracting and they described ads as "money grab". The comments are in line with Chik's (2014) findings that some apps have third party pop-up ads that distract learners. However, the users and Chik appear to have neglected the factor of the app development and marketing expense, and that the developers usually depend on in-app purchases or ads to cover these costs (Sweeny & Moore, 2012). From this perspective, ads seem to have a good reason to exist. Even so, it is important that the app developers should be careful about the time and frequency the ads pop up. This is because inappropriate use of ads may increase the user's affective filter level (Krashen, 1989), which defeats the learning purposes.

6.2.3.4 App Support.

The findings show that all three apps in this study provide app support. One common way for app to provide support is the in-device email option where users can access a link to send feedback or requests to the app developers. In addition to the aforementioned support feature, *Duolingo* has an online help center where users can access frequently-asked questions and answers. *Duolingo* also supports learners by regularly updating the app based on users' requests. With all these supports, *Duolingo* learners may be able to navigate the app more easily by themselves and therefore increase their autonomous learning. *AnkiApp* has an

in-app help center that answers frequently-asked questions. However, some users' comments reveal that other support functions in *AnkiApp* does not provide sufficient app support. One user commented that "this app is actually a poorly supported rip off".

In addition to the existing support features, users also requested additional app support such as more frequent app updates, more forms of multimedia, more learning activities, more opportunities for social interaction, and a section to explain the vocabulary prior to users' practicing the learning activities. These users' requests are consistent with my discussion of the app features in this section in terms of the app productivity and design.

6.3.2.5 Technical elements.

It should be noted that one app feature that emerged from the user reviews is that all three apps are prone to technical errors. Some common technical issues reported by the users are: the app judging the learners' correct answers wrong, forced quits, and errors in multimedia (e.g., microphone issue, audio not matching the learning pace). *AnkiApp* was reported by 60% users to have problems such as app operation crash, failure to create cards, failure to save cards, and difficulty to download cards. Technical issues may bring some potential hindrances to the learners and diminish learning efficiency. When errors happen during the learner's learning process, it may interrupt their learning progress. Learners may lose their trust towards an app if technical errors especially content mistakes happen (Berns et. al., 2015; Niño, 2015), thus resulting in a high affective filter for the learner (Krashen. 1989).

6.3.2.6 Summary.

In this sub-section, I discussed some app design features. Similar to the curriculum and pedagogical features, some app features are well-designed, while others need improvement. Well-designed features include various forms of multimedia in the learning and practice activities in *Duolingo*, good app support in *Duolingo*, and full off-line access to

all quizzes in *Johnny Grammar Word Challenge*. Other features that need improvement are limited forms of multimedia in *Johnny Grammar Word Challenge*, limited off-line access in *Duolingo* and *AnkiApp*, disturbing ads in *Duolingo* and *Johnny Grammar Word Challenge*, and technical errors in all three apps.

6.2.4 Conclusion

This section discussed the app features of *Duolingo*, *Johnny Grammar Word Challenge*, and *AnkiApp* in the aspects of curriculum, pedagogy, and design. A quality app has curriculum elements such as learning objectives, rich and appropriate learning content, various content activities, lessons, and units, accurate content, and learning topics. A productive app has the following features: detailed feedback, articulated levels of difficulty, social interaction and collaboration, social context, well-incorporated gamification elements, and personalized options. A well-designed app provides well-incorporated multimedia elements, off-line access, app support, no distracting ads, and no technical error that influence learning. The main findings of the app features are that none of the selected vocabulary learning apps contain all the exemplar features.

The exemplar app features of the three apps in this study are:

(a) *Duolingo* has quality features including learning objectives, rich and appropriate content, content activities, and learning topics; productive features including some gamification functions (e.g., rewards), personalized options (e.g., saving learning progress, placement test); well-designed features including purposeful use of various forms of multimedia, off-line function for the lessons and various ways of app support.

(b) *Johnny Grammar Word Challenge* has quality features including appropriate content, accurate content, content activities, and learning topics; productive features including use of social contexts, some gamification features, and

personalized options; well-designed features including full off-line access to the quizzes, and app support (e.g., in-app "Feedback & Support").

(c) *AnkiApp* has quality features including rich and appropriate content, and accurate content; productive features including personalized options; well-designed features including various forms of multimedia, and free of ads.

The app features that need improvement are:

(a) *Duolingo* has content mistakes, no detailed feedback, unclear levels of difficulty, no in-built opportunities for collaborations among learners, limited social context, upper five mistakes limit in the learning process, inaccessible quizzes off-line, distracting ads, and technical elements.

(b) *Johnny Grammar Word Challenge* indicates no learning objectives, includes limited learning content, limited forms of learning activities, no detailed feedback, unclear levels of difficulty, no in-built opportunities for collaborations among learners, the 60 seconds time constraint in each quiz, carries distracting ads, and some technical elements.

(c) *AnkiApp* has no learning objectives, limited learning content, limited forms of learning activities, no learning topics, no detailed feedback, unclear levels of difficulty, no collaborations among learners, limited social contexts, poor app support, and technical hindrances.

Although *Duolingo, Johnny Grammar Word Challenge,* and *AnkiApp* have some exemplar app features, these apps need updates to address the app features that are not quality, productive, or well-designed in order to meet the standard of an exemplar app.

I did not discuss the classroom feature, app transaction, and learners age group because these features are unique to one app and these features are not common in this study.

6.3 App evaluation checklist

The app evaluation checklist (see Table 8) was developed based on existing literature and the Ontario ESL curriculum. This checklist was further developed according to the findings of the in-depth analysis on the three vocabulary learning apps in this study. The modified app evaluation checklist includes all the quality, productive, and well-designed app features that an ESL learning app may have in the aspects of curriculum, pedagogy, and design. Therefore, this app evaluation checklist has the potential to be used as a tool to select quality, productive, and well-designed ESL learning apps. This checklist may also apply to ESL learning apps that focuses on other language learning skills, and for learning other languages. For example, *Duolingo* and *Johnny Grammar Word Challenge* focuses more than one learning skills, and *Duolingo* and *AnkiApp* focus on more than one language.

6.4 Limitations of the Study

Creswell (2007) defined limitations as "potential weakness or problems with the study identified by the researcher" (p. 199). This study had the following limitations:

a) The app content updated fast, and when I went back to check the *Duolingo* app four months after data collection, the units had already been updated from one level to three levels of difficulty. *Johnny Grammar Word Challenge* and *AnkiApp* also had new updates. Therefore, I may not have captured the most up-to-date features.

b) I studied ESL apps that cost less than $10 CAD. Apps that exceed $10 CAD might contain additional features that could expand the categories and criteria in my app evaluation checklist.

c) I studied ESL apps from the US iTunes app store and Google Play app store which is also accessible in Canada. Performing this study in another country out of North America where different apps may be available could result in different findings.

d) *AnkiApp* only had 71 user reviews, which is far fewer than *Duolingo* and *Johnny Grammar Word Challenge*, for which I studied 631 user reviews each. I was unable to ascertain why *AnkiApp* had limited user reviews and if these reviews were representative of the views of the users who did not write reviews for this app.

6.5 Contributions and Possibilities for Future Studies

Integrating technology into curriculum and instruction is common in the 21st century. Learning apps are frequently used and recommended for language learning in and out of the classroom. As there was limited literature that recommend ESL learning apps, the *App Recommendation List* (see Table 2) contributed a list of learning apps for teachers, parents, learners, and others who seek ESL app recommendations. The in-depth content analysis of the app features of *Duolingo*, *Johnny Grammar Word Challenge*, and *AnkiApp* unpacked the app features of ESL learning apps in three aspects—curriculum, pedagogy, and design. The findings bring to light the app features in detail, which is useful for app developers as well as educators who are interested in developing or in the development of language learning apps. As is noted previously in this chapter, I also developed an app evaluation checklist (see Table 8). This tool has the potential to provide educators, teachers, and individual learners with support in selecting quality, productive, and well-designed ESL learning apps, learning apps that focuses on other English learning skills, and learning other languages in order to meet teaching and learning goals.

This study also contributed several possibilities for future study.

First, future studies may explore the potential and effectiveness of apps that cost more than $10 CAD. Although I labelled the apps in the app recommendation list in Table 2 as “the most recommended apps”, the selection criteria limited the sample to apps that I considered to be affordable for learners. Appendix B shows the most recommended apps among the 144

apps in Appendix A and the number of times these apps were recommended. The majority of these apps were not in Table 2; in fact, most of the apps listed in Appendix B (e.g., *Busuu, Memrise, Rosetta Stone, Babbel*) usually cost more than $10 CAD per month. These expensive apps are popular among learners and they may be quality, productive, and well-designed apps. Therefore, there is a need for future research to explore the potential and effectiveness of expensive (more than $10 CAD) apps, which may provide teachers, learners, and parents with new opportunities when choosing apps for study purposes.

Second, researchers could study how *Duolingo, Johnny Grammar Word Challenge,* and *AnkiApp* continue to improve their app features in response to user reviews. For example, although the apps I studied all have social interaction features, users stated that they would like to be able to interact and learn with their friends on the app through social media (e.g., Facebook). Future research could explore how to develop an effective social interaction function in an app.

Third, the app evaluation checklist I developed has not yet been put into practice. It might be worthwhile to do further research in a school setting to examine the practical effectiveness of this evaluation tool, to see how it helps teachers, students, and parents in choosing ESL learning apps. For instance, research could be carried out to validate the app evaluation checklist through questionnaires or other ways.

Fourth, I found few reading apps and no writing apps in the literature and my research. There are research possibilities for designing and studying ESL apps for reading and writing purposes to fill this gap.

6.6 Conclusion

The findings of this study has shown that listening and vocabulary learning apps are dominates the app market by apps that enhance language skills. Although more ESL learning apps that focus on grammar, pronunciation, and speaking were recommended in recent years,

I found few reading apps and no writing apps. All three vocabulary learning apps in this study have some exemplar app features in curriculum, pedagogy, and design, but I did not mark these apps as exemplar apps because some app features need improvement such as incorporating detailed feedback, articulating levels of difficulty, adding social interaction and collaboration, and solving technical problems. I developed the app evaluation checklist based on the literature, the Ontario ESL curriculum, and my findings. The app evaluation checklist covered all the app features I discussed in this chapter.

To conclude, the ever-increasing popularity of learning apps is becoming ubiquitous in and outside classrooms and have a potential impact on classroom teaching and students' learning experience. There is little literature that studies language learning apps, and app users lack evaluation tools to evaluate the app quality. In response to the literature. this study explored app features of selected vocabulary apps, and provided an app recommendation list and an app evaluation tool. The app evaluation checklist as an evaluation tool has the potential to be used by teachers and educators, parents, students and other people who are interested in using and studying ESL learning apps to evaluate the app quality to choose appropriate ESL learning apps. It may also benefit school administrators and policy makers who look into policy on use as well as purchase of apps for use on school-based devices and sites.

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APPENDIX A
App Recommended from Multiple Resources

No.	Recommendation Sources	Recommended Apps	Website
1	edutopia	Kids' Vocab - MindSnacks, English First High Flyers, Flashcardlet, Futaba	https://www.edutopia.org/blog/apps-support-ELL-vocabulary-acquisition-monica-burns
2	edutopia	duolingo	https://www.edutopia.org/blog/apps-support-diverse-learners-classroom-chester-goad
3	Busy Teacher	Busuu, SpeakingPal English Tutor, Voxy, MyWordBook, Conversation English, English Grammar in Use Tests, IELTS Master Vocabulary Guide, Cambridge Advanced Learners' Dictionary, Oxford Deluxe Dictionary and Thesaurus of English.	https://busyteacher.org/12155-9-best-mobile-apps-for-esl-students.html
4	Ipad in the ESL Classroom	Facetime, Camera app, Converation English, sentence builder, Intro to Letters, speech tutor, Idaily Pro, Hello- Hello, Clear Speech fro the Start, Wordbook XL-English Dictionary and Thesaurus, Busuu, Adventures for Kids, Longman Dictionary of Contemporary English, Phonetics Focus, English is Easy. BERLITZ MY ENGLISH COACH, PUPPET PALS, THE CAT IN THE HAT	https://ipadintheeslclassroom.weebly.com/esl-apps.html
5	Masters in ESL	Phonetics Focus, American Wordspeller ESL, VoiceThread, ESL Podcast- Unofficial, Learn To Talk More Words, ESL Edition-eCOVE Software,TeachMe: Kindergarten & Teach Me: 1st Grade, ESL Player, Learn English, ESL, TOEFL,Learn English, Supiki English Conversation Speaking Practice, Speech With Milo Apps, Pogg — Spelling & Verbs, Kidioms,iGE: the interactive Grammar of English from UCL, ESL Pod ensider,Speak ESL English Free, Grammar Up.	https://mastersinesl.com/essential-esl-app-guide/

6	Larry Ferlazzo	Duolingo, Speaking Pal, English Central, Lingua.ly	http://larryferlazzo.edublogs.org/2014/01/31/the-best-mobile-apps-for-english-language-learners/
7	New York Times	Practice English Grammar, Learn English Grammar, Grammar Up	https://www.nytimes.com/video/technology/personaltech/100000003476171/app-smart-improve-your-english.html?src=vidm
8	Android Authority	Busuu, English in a Month Free, Learn English Elementary, Babbel, Voxy, WordTalk, Test Your English I, ESL Daily English, Spell Checker, TheFreeDictionary.com – Farlex	https://www.androidauthority.com/best-english-learning-apps-for-android-95816/
9	FluentU	FluentU, Rosetta Stone,MindSnacks, Memrise, Open Language, Mosalingua, Busuu, Duolingo.	https://www.fluentu.com/blog/english/best-apps-learning-english-esl-students/
10	Free Technology for Teachers	English Monstruo, Phrasalstein, Duolingo, Lingualy, Forvo	https://www.freetech4teachers.com/2014/03/5-good-apps-for-esl-ell-students.html#.Ww4XcUxFxjp
11	Best Colleges Online	Intro to Letters, Sounds Right, Sentence Builder, Speech Tutor, iDaily Pro, Hello-Hello, Basic Pronunciation, WordBook XL, Busuu, Adventures for Kids, Word Wit, Longman Dictionary of Contemporary English, Phonetics Focus, Sounds:The Pronunciation App, Berlitz My English Coach for iPad; English is easy	http://www.bestcollegesonline.com/blog/16-incredible-ipad-apps-for-esl-learners/
12	Educational Technology & Mobile Learning	Kidioms, Phrasalstein,Wordbook, Preposition Builder, Basic Pronunciation, Intro to Letters, Rainbow Sentences, Conversation English, Adventures for kids, English is Easy	https://www.educatorstechnology.com/2014/03/10-great-ipad-apps-for-learning-english.html
13	Bustle	Duolingo, Anki, Memrise, Hello Talk, Rosetta Stone, FluentU	https://www.bustle.com/articles/74329-6-apps-for-learning-languages-ranked-by-how-you-like-to-study
14	DontPayFull	The American Foreign Services Institute, Babbel, Memrise, Busuu, BBC Languages, Duolingo, Byki, Openculture, Learn a Language, HiNative	https://www.dontpayfull.com/blog/learn-a-language-for-free%20(with%20description)

15	Fluency Spot	Memrise, Duolingo, Lang-8, Lingq, FluentU, Babbel, Busuu, Digital Dialects, FSI, My Language Exchange (.com)	https://fluencyspot.com/learning-languages-for-free/
16	app annie	Duolingo,Tandem, Bright, Babbel, Memrise, Busuu, Rosetta Stone, Drops, Lingo Play, Mondly, Learn English with ABA English	https://www.appannie.com/dashboard/home/?_ref=header
17	British Council	Sounds Right, Johnny Grammar's Word Challenge, LearnEnglish Sports World; LearnEnglish Kids: Phonics Stories (age 6-8), LearnEnglish Kids: Videos (age 7-11), LearnEnglish Kids: Playtime (age 6-11) , learn English Grammar*2, IELTS word power, LearnEnglish GREAT Videos, learning English Podcast, LearnEnglish Audio & Video	https://www.britishcouncil.org/english
18	Professionally Speaking	Memrise, VocabularySpellingCity, Kid's Vocab, Ninjawords, Quizlet	http://oct-oeeo.uberflip.com/
19	Teachthought	Memrise, Rosetta Stone, HelloTalk,Busuu, Voxy, learn English Easily	https://www.teachthought.com/technology/best-language-learning-apps-2015-ipad-learn-english/
20	Edudemic	iTranslate, iVocabulary, Free Translate, Translator with voice, Lexicon, World Nomads Language Guides, iSpeak, Byki, Gengo Wordpower, iSign	http://www.edudemic.com/the-90-best-ios-apps-for-mobile-learning/
21	Literature Review	Duolingo, Busuu, Listening Drill, TheFreeDictionary, Dictionary.com, Google Translate, the personalized intelligent mobile learning system, Lingo Arcade,English LaunchPad, Guess it! Language Trainer, Idioms app, English Pronunciation, the clear Speech appWiktionary, Courier International,Der Spiegel, WhatsApp, Facebook Messenger, VISP (VIdeos for Speaking), Wrodreference, Dict CC, LEO, Pons, Linguee, iTranslate, Babble, Memrise, Quizlet, Brainscape, Anki, MindSnacks	

APPENDIX B
Apps Recommended the Most Number of Times [17]

No.	App Name	Number of times	Price (iTunes)	Price (Google Play)	iPhone/iPad	Google Play
1	Busuu	10	in-app purchase (12.49$/month)		both	Yes
2	Duolingo	9	free (all content)		both	Yes
3	Memrise	8	in-app purchase (11.99$/month)		both	Yes
4	Babbel	5	in-app purchase (19.99$/month)		both	Yes
5	Rosetta Stone	4	in-app purchase (279.99$)		both	Yes
6	Voxy	3	in-app purchase (39.99$/3 months)		iPhone	Yes
7	Hello Hello	3	in-app purchase (27.99$)	free	both	Yes
8	MindSnacks	3	in-app purchase		iPhone	
9	Conversation English	3	in-app purchase (2.79-6.99)	in-app purchase (2.78-6.96)	both	Yes
10	Intro to Letters	3	6.99$	4.09$	both	Yes
11	AnkiApp	2	free	free	iPhone	Yes
12	Grammar Up	2	6.99$	in-app purchase	both	Yes
13	Hello Talk	2	in-app purchase (6.99$)	2.79$	both	Yes
14	HiNative (Lang-8)	2	in-app purchase (13.99$/ month)	in-app purchase	iPhone	Yes
15	iTranslate	2	in-app purchase (49.99$/year)	in-app purchase	iPhone	Yes
16	Learn English Elementary	2	free	free	both	Yes
17	Learn English Grammar	2	free	in-app purchase	both	Yes
18	Quizlet	2	in-app purchase (15.49-43.99$)	in-app purchase	iPhone	Yes
19	Sounds Right	2	free	free	both	Yes
20	SpeakingPal	2	in-app purchase (34.99$/year)	in-app purchase	both	Yes
21	Tandem	2	in-app purchase (43.99/year)	in-app purchase	both	Yes
22	TheFreeDictionary.com-Farlex	2	in-app purchases	in-app purchase	both	Yes

[17] Here most times refers to an app recommended by more one source as a top language learning app. Johnny Grammar Word Challenge and AnkiApp are not in this list because they only showed up once in the recommendation resources.

APPENDIX C
Commonly Recommended ESL Learning Apps for ECE Learners

App Name	**App Store**	**Language Skills**	**price**
hip hop hen abc flashcards	iTunes	phonetics, vocabulary	3.99 CAD
Oz Phonics	BOTH	phonetics	4.49 CAD
Alphabet Sounds Word Study	BOTH	phonetics	3.99 CAD
The Joy of Reading	BOTH	phonetics, reading	5.49 CAD
Montessori Letter Sounds	iTunes	phonetics, reading	5.49 CAD
ABC House	iTunes	vocabulary	3.99 CAD
Wee Sing & Learn ABC	iTunes	alphabet; listening	3.99 CAD
Mr Thorne's Phonics Flash Cards	iTunes	phonetics	2.79 CAD
Mr Thorne's Phonics Safari	iTunes	phonetics	2.79 CAD
Spellyfish Phonics	iTunes	phonetics	3.99 CAD
LearnEnglish Kids: Phonics Stories	iTunes	phonetics	free
LearnEnglish Kids: Playtime	iTunes	reading, listening and speaking	free
LearnEnglish Kids: Videos	Googple Play	listening and reading	free

app recommendation sources：

http://parentingchaos.com/phonics-apps-for-kids/

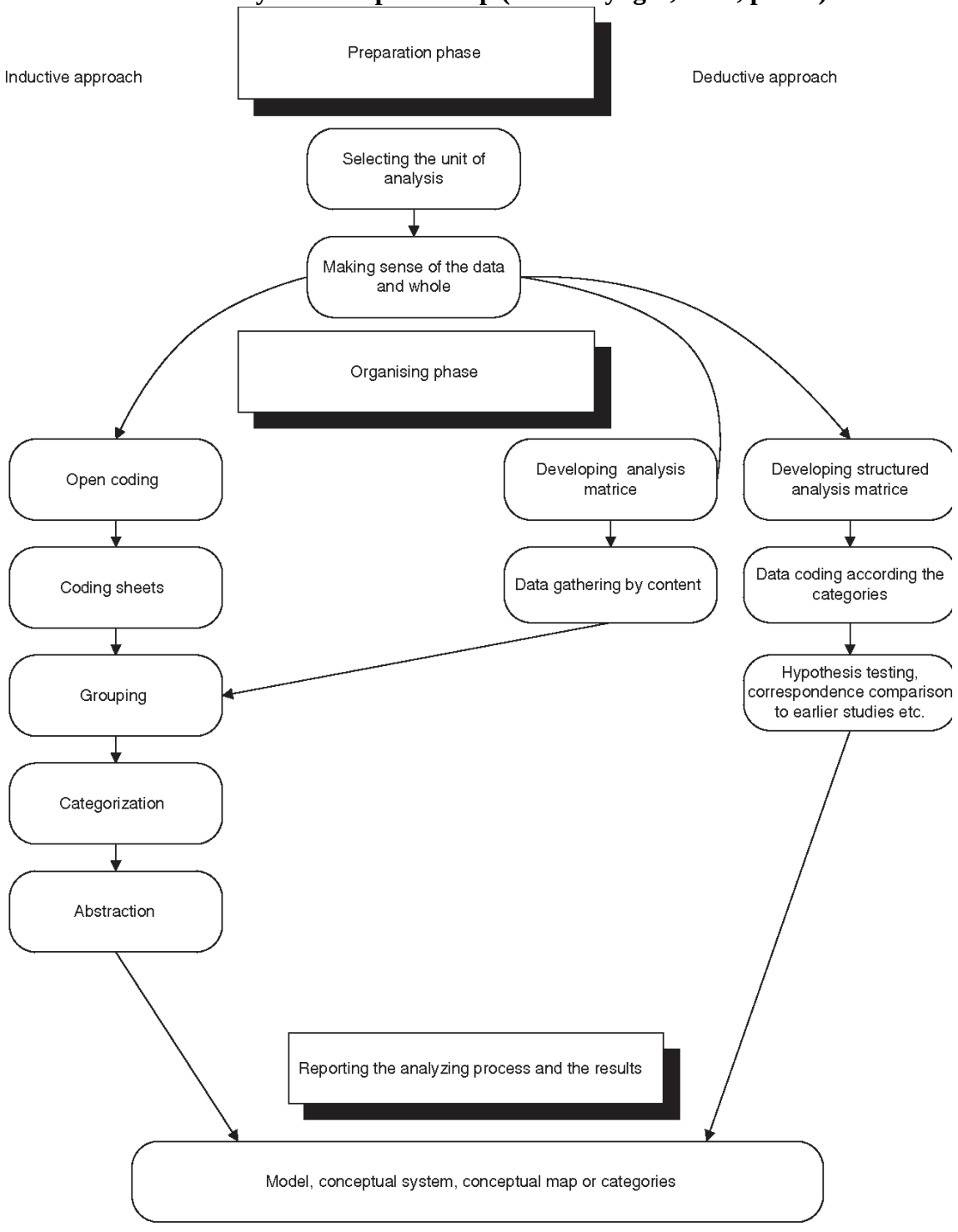
https://www.educationalappstore.com/app-by-age/earlyyears
https://www.britishcouncil.org/english

http://oct-oeeo.uberflip.com/

https://www.early-childhood-education-degrees.com/30-ipad-apps-for-early-childhood-education/

APPENDIX D

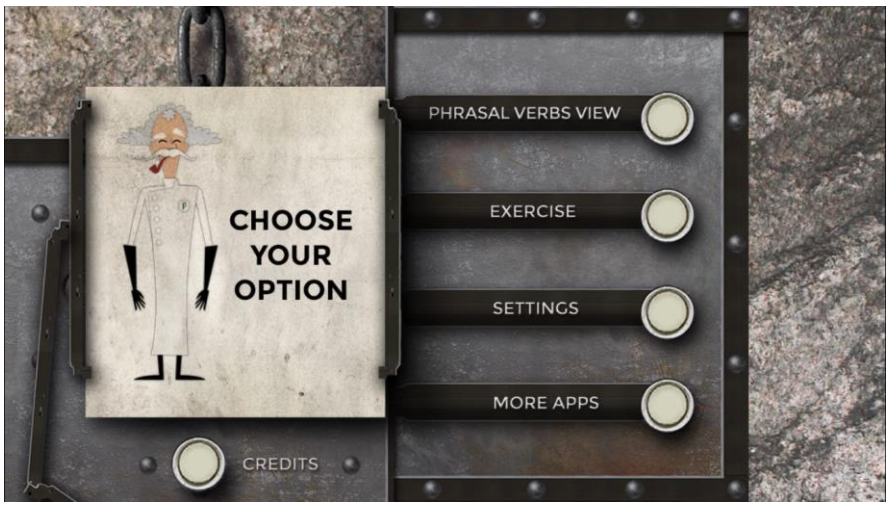
Data Analysis Conceptual Map (Elo & Kyngas, 2008, p. 110)



APPENDIX E
Additional Data

Phrasalstein App

When entering the main page, music is on immediately and throughout the entire use of app. The music can be configured in the S*ettings*. The main page includes 4 options to choose—*Phrasal Verbs View*, *Exercise*, *Settings*, and *More Apps*.



When entering the phrasal verbs view, there are home and setting option on the upper left corner. The learning activities are presented through animated stories. Two doors are available on the screen: the left smaller door presents phrasal verbs. Users can choose a verb on the left side to match a preposition on the right, and accordingly, when the user clicks "view", the right bigger door will open with an animated story that represent the meaning of the phrasal verb on the left.

The app does not save learning progress for the users. 82 verbs are listed according to alphabet order A to Z, and each verb may have 1-5 prepositions to choose from to form a new phrasal verb. From the researcher's experience, this is very limited choice of phrasal verbs, and some of them are not used often such as "moon over" and "laze about". As the animated videos are the only information for the meaning of the phrasal verbs, and no subtitle or extra texts are available to explain the meaning, it's difficult to guess the meaning and know if the meaning is correctly understood by the learners.

In the *Exercise*, a big door on the left side of the screen shows the animated stories, and a small door with five answers is presented on the right side of the screen. The user is required to choose the correct phrasal verb according to the animal video. When the choice is made, click "OK" to check the answer which is presented on the left side of the screen. Then, then feedback will be given to the user. However, when the user has made a wrong choice, the app only provides the correct answer without detailed explanation. Below the left screen, two icons show the number of the finished exercise, and the number of errors.

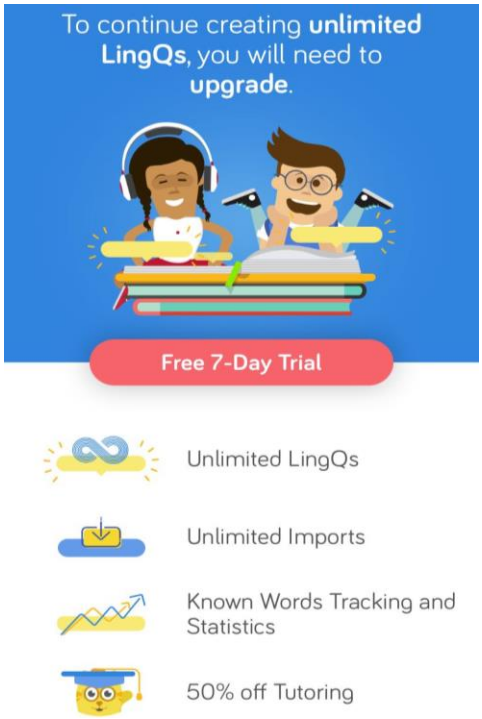
The *Settings* contains shortcut icons that direct users to the home page, *Phrasal Verbs View*, and *Exercise* on the top of the page. In the middle are choices of interface languages (e.g., English, Spanish, Italian, French, Portuguese, German, Russian), sounds (on/off), and music (on/off). At the bottom are legal notice app and instructions to use the app.

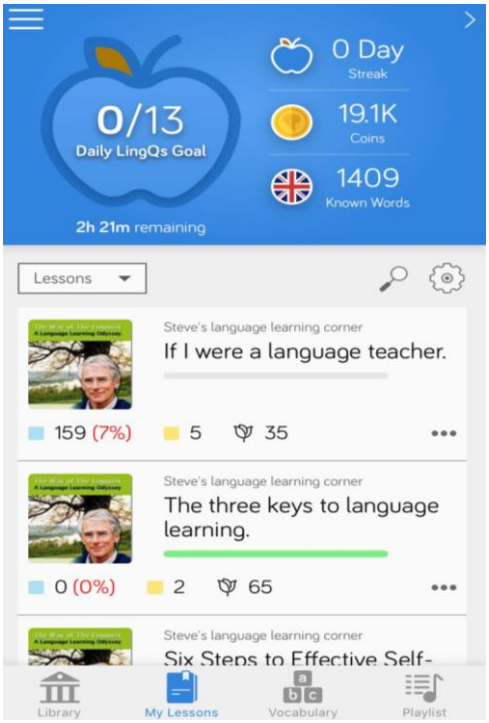
LingQ App

When the user access the app the first time, it takes the learner to a webpage to choose language (Spanish, English, German, Japanese, Russian, French, Swedish, Italian, Portuguese, Chinese, Korean, Dutch, Greek, Ukrainian, Arabic (Beta), Czech (Beta), Finnish (Beta), Hebrew (Beta), Norwegian (Beta), Romanian (Beta), Turkish (Beta), Slovak (Beta)),

and English level from beginner, intermediate, to advanced. After choosing language and learning level, a page popped up to ask the user to ‘activate LingQ Freemium FREE for 7 days’. With a LongQ Freemium, the user can get unlimited access to everything LingQ offers (e.g., unlimited LingQs, Unlimited Imports, known words tracking and statistics). A red icon shows the option to “Activate” is highlighted at the middle of the page, and the ‘No, thanks’ was placed at the very bottom of the page with small, grey format.

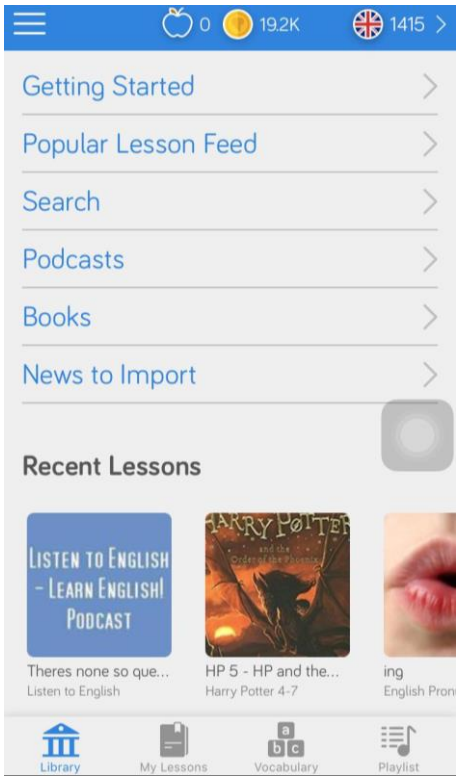
The in-app purchase to use the full app content is 13.99 per month. Four icons at the bottom of the app help learners to navigate the learning activities: *Library, My Lessons, Vocabulary,* and *Playlist.*

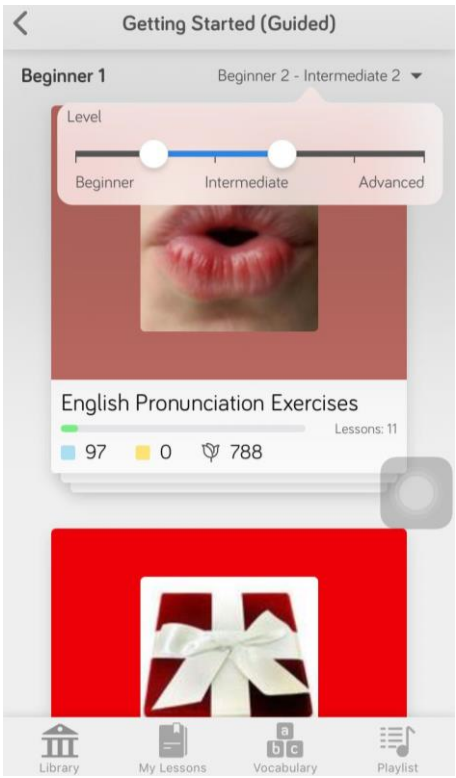




The *Library* is the main page, which provides learning content in six sections to the users. In the content page, the user can choose lessons, topics, or courses according to their English proficiency, from beginner to advanced. “Getting started” presents lesson topics for learners of different English proficiency. The learner can choose their English level, and each level presents 30 learning units with different topics and each unit contains several lessons. The number of lessons in each topic varies from topic and from the English level. The “popular

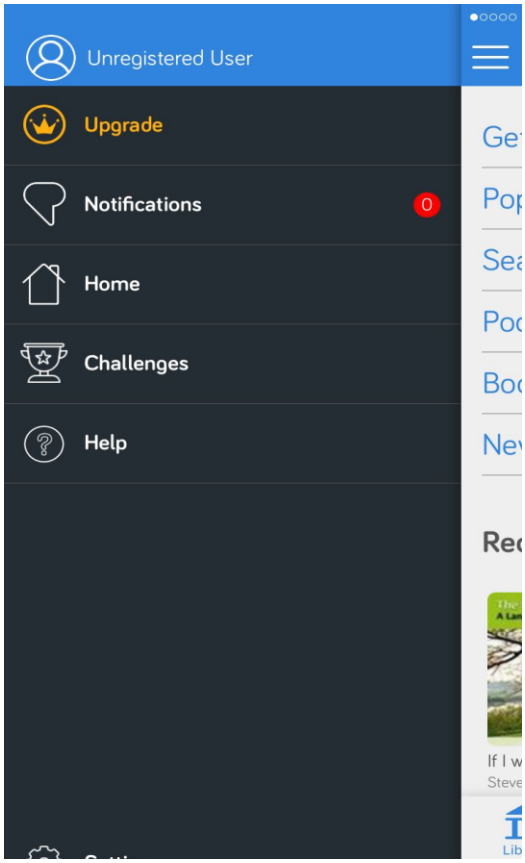
lesson feed" presents lessons that are most popular among learners of different English proficiency, but not all the lessons have a topic. "Search" takes users to the page where they can search by lessons or courses and by English proficiency. After "search" are "podcasts" and "book", which allow the users to access lessons or courses offered by podcast. 50 units are available in both sections, and similar to "get started", each unit has several lessons. The section followed is "news to import", and this section provides learners with CNN news that they can import to the app. Below these six sections are lessons the user recently reviewed.

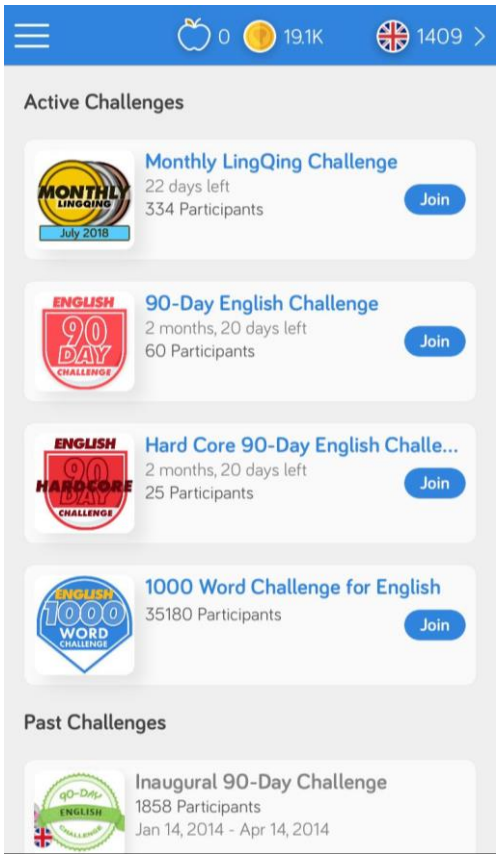




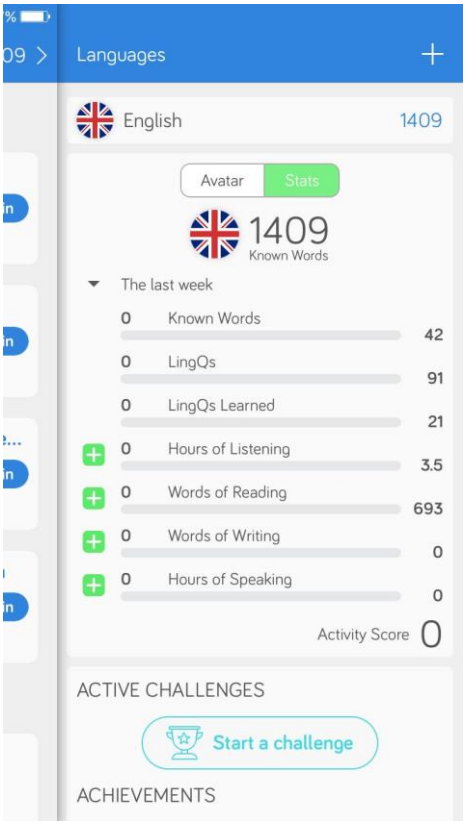
The icon on the top left corner of the main page shows information of the user's profile, including registered user name, upgrade options, notification, challenges, and help. When clicking on the user's user name, which shows "unregistered user" when the user does not have an account, it gives the user the choice to stay or log out. The "upgrade" option takes the user to the LingQ Freemium page. "Notifications" show notices from the app, and the "home" option navigate the user back to the main page. "Challenges" is a social interaction app feature that allows the users to join different challenges, and each challenge has a

leaderboard, which shows the learner's rank and points. This page shows all the active challenges and past challenges programs the app has. In each active challenge, it shows the time left for the challenge, the number of participants, and a "join" icon.

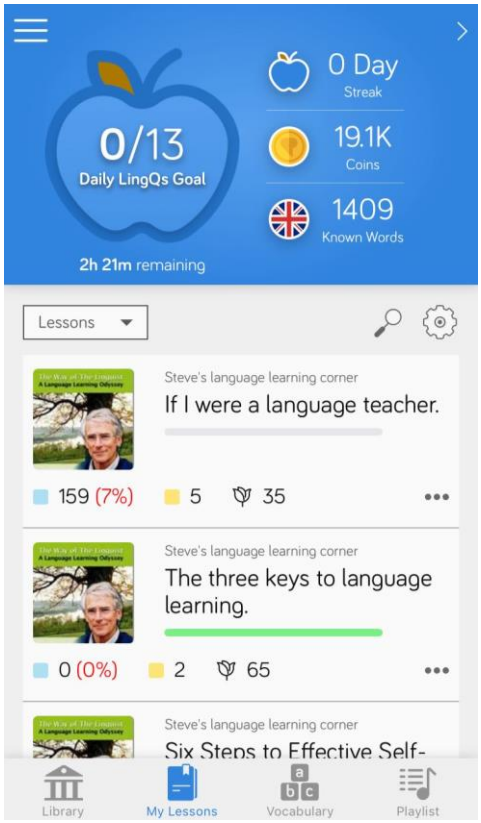




On the right side of the main page is an icon showing the language the user is currently learning, and the number of user's known words. This icon brings the user to a page with more details. It shows the user's learning progress in the past week. The user can choose to see progress on yesterday, the last month, the last 6 months, and so forth. This page shows the learner's known words, words need to learn (also called LingQs), LingQs learned, hours of listening, words of reading, words of writing, and hours of speaking. Activity score is shown below this information. On the bottom of page is another place besides the profile page where the active challenges and learner's achievement can be accessed.



My lessons present all lessons the user chose from the library. When first accessing a lesson, a “quick start guide” will show up to explain what different icons in the lesson means and how to use them.: (a) Tap on words with blue color if the learner does not know the word, and when a word with blue color is tapped, it becomes yellow, and is added to the vocabulary. (b) The user can add a translation using the learner’s chose language to the yellow words and build their own vocabulary. (c) The words marked yesllow will show up in the future lessons, and as the user learns these words, they can increase their status of knowing the words. For example, there is a 1 to 4 scale, which represents how familiar the word is to the learner. (d) All the other words in each page become known words, which are not marked with any color.



Settings have the following information:

App: (a) user's profile*;* (b) feedback option which takes the user to an email editing page to send the app developers feedback or requests; (c) general which gives the learner choices to download playlist on 3G with an on/off icon; (d) Interface language which takes the user to a page where 11 interface languages are listed through alphabet order; (e) notifications.

Reader: (a) general, which allows users to choose if they hope to have functions including sentence mode, paging move to known, review LingQs while paging, auto LingQ creation, and their choice of dictionary language; (b) font; (c) style; (d) text to speech function and voice.

Review: (a) general including cards per session and shuffle cards or not; (b) choice of activities including flashcards, reverse flashcards, cloze, multiple choice, and dictation.

Curriculum Vitae

Name: Luyi Liang

Post-secondary Education and Degrees:

Western University
London, Ontario, Canada
2018 Master of Arts, Education (Curriculum Studies)

Leshan Teacher's College
Leshan, Sichuan, China
2013 Bachelor of Arts, English Education

Honors and Awards:

Mitacs Globalink Research Award (2018)

Art Geddis "Learning About Teaching" Memorial Award (2018)

Graduate Student Internal Conference Grant (2018)

Inclusive Education Research Award (2018)

Joan Pedersen Memorial Graduate Award (2018)

Global Opportunities Award (2017)

Symposium on Computational Thinking in Mathematical Education travel fund (2017)

Work Experience:

Research Assistant (2018)
Western University
Canada

ECE Educator (2017-2018)
Whitehills Childcare Association
Canada

English Teacher (2013-2016)
Leshan Foreign Language School
China

Teaching Assistant (volunteer) (2012)
Great Bay Discovery Center
US

Paper and Abstract Acceptation

7th Annual International Conference for Language, Literature and Linguistics (paper accepted, presented, and published) (2018)
Singapore

Rosa Bruno-Jofré Symposium in Education (2018) at Queen's University (Abstract accepted) (2018)
Queen's University, Canada

Western Research Forum (Abstract accepted) (2018)
Western University, Canada

Robert Macmillan Graduate Research in Education Symposium
(Abstract accepted and presented) (2018)
Western University, Canada